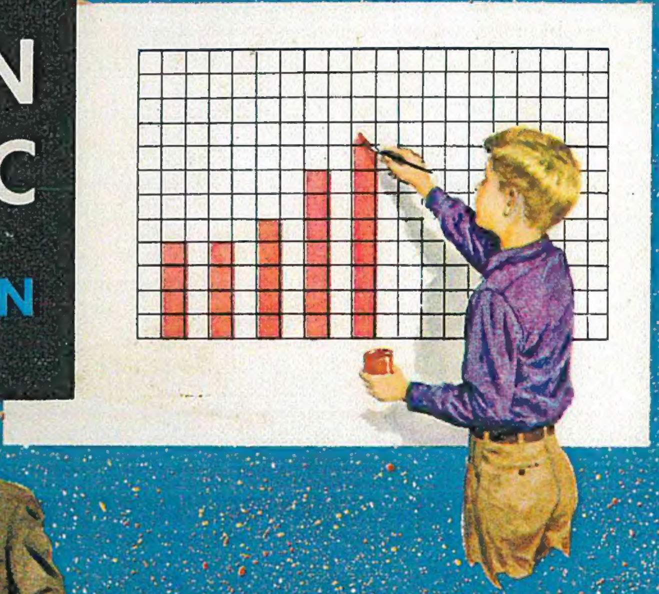
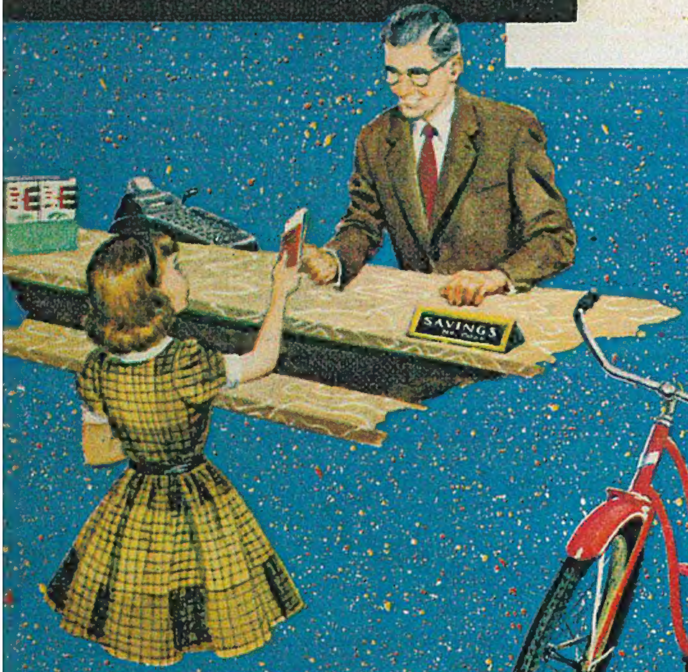
6

GROWTH IN ARITHMETIC

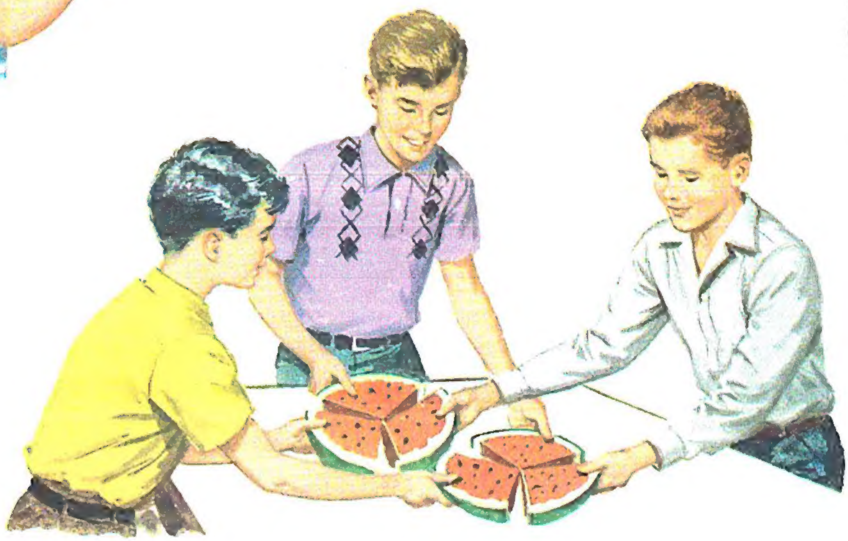
REVISED EDITION





Growth In Arithmetic (Revised Edition)—Grade 6

GROWTH



REVISED EDITION • **GRADE SIX**

IN ARITHMETIC

BY John R. Clark
Charlotte W. Junge
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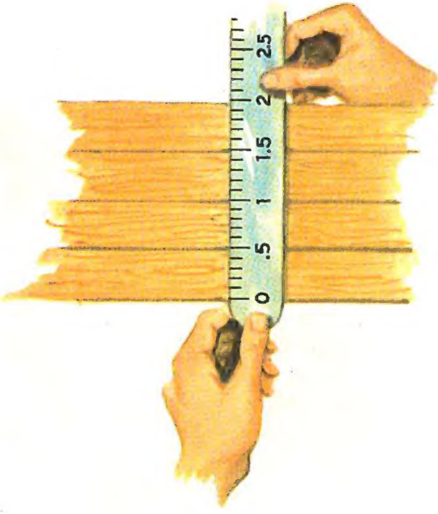

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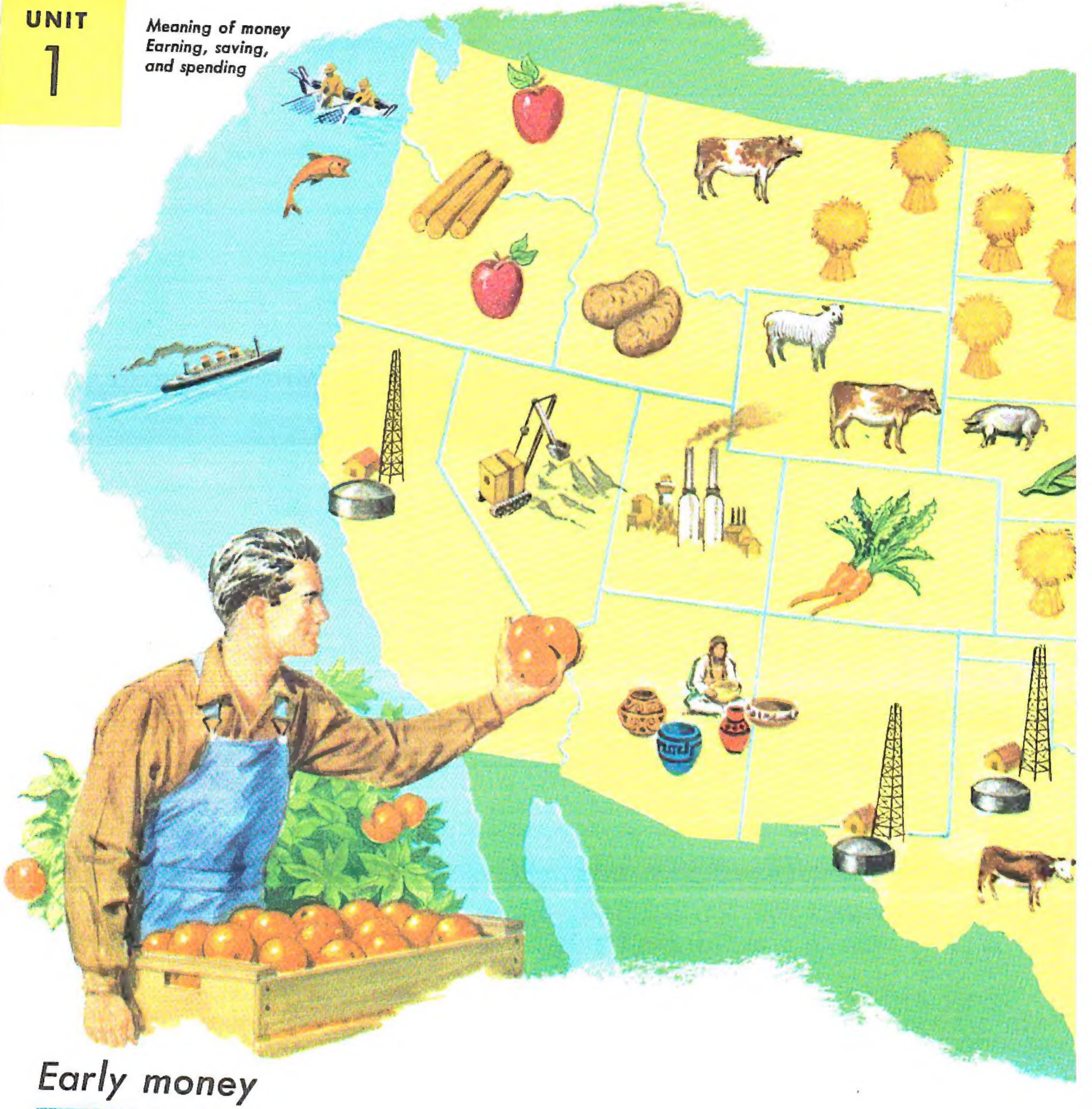
UNIT 1

Meaning of money
Earning, saving, and spending



Early money

Because so many arithmetic problems deal with money, you might ask yourself the question, "What is money?" So many of our needs are met by earning and spending money that it would be hard to imagine what life would be like if there were no money. Yet for a long time there was no money as we know it today.

In the days of primitive tribal life, if a man wanted a tool owned by a neighbor he had to find something among his possessions to trade for the tool. This form of trade is known as *barter*.

Today bartering would be an unsatisfactory way of doing business. For example, what problems would arise if an owner of an orange grove wanted to buy a pair of shoes; or if a man wanted a new hat, but had only a horse to trade?

Gradually tribes began to think of better ways to exchange goods. Furs, jewels, grain, arrowheads, beads, shells, and so on, were soon accepted in trade for what they would buy, rather than because the owner needed these things for his own use. These materials became the first money.

About coins

The use of certain articles as money was an improvement over bartering. However, many of the things used as money were unsatisfactory. If a man's wealth was in grain, think what would happen if worms got into the grain or if it became moldy!

Gradually pieces of copper, silver, and gold began to take the place of such things as furs, jewels, and grain. The use of metal coins caught on fast because coins were more permanent than skins or grain. Besides, it was easy to divide metals into coins of different values for making change.

To protect their citizens and to reduce trade difficulties, governments took over the task of making money. In the United States today, paper money is printed in Washington, D.C. Metal money is minted in Philadelphia, Denver, and San Francisco.

1. In a recent year the total number of coins minted was:

372,000,000 pennies
145,000,000 nickels
163,000,000 dimes
68,000,000 quarters
7,000,000 half dollars

Find the value in dollars of the pennies made in that year.

2. Which is worth more, the 372 million pennies or the 7 million half-dollar pieces?

3. Why do you think so many pennies are needed?

4. A ten-dollar bill is worth as much as _?_ pennies, or _?_ nickels, or _?_ dimes, or _?_ quarters, or _?_ half dollars.

5. A dime is what part of a half dollar? a dollar? 10 dollars?

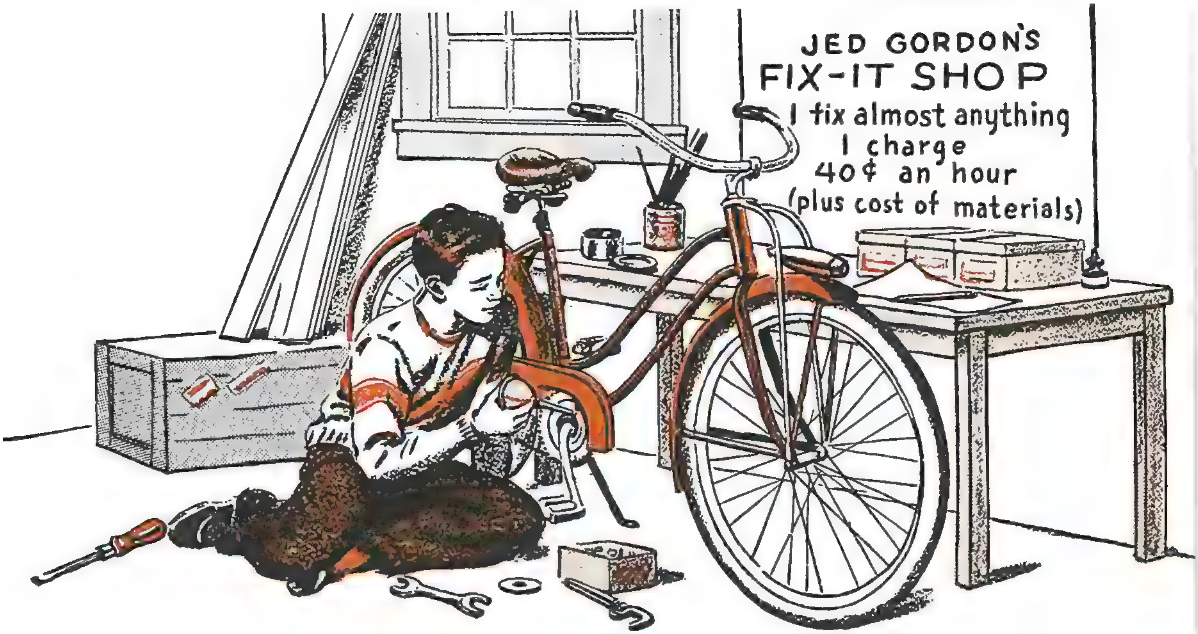
6. What is the smallest number of coins you can get in change from a dollar when you make a 16-cent purchase?

7. Mary gave the class this puzzle: Daddy has $80 in paper money. He has the same number of 1-dollar, 2-dollar, and 5-dollar bills. How many of each kind does he have?

8. Peter said, "I can name 5 pieces of paper money that add up to 163 dollars." Can you? (Remember that there are 10-, 20-, 50-, and 100-dollar bills.)

9. Find out about the Indians' use of wampum for money.

10. Explain: Our money system is a tens, or decimal, system.



Earning money

1. Look at Jed's "Fix-It Shop" sign. How much does he charge per hour?

He spent $2\frac{1}{2}$ hours putting a coaster brake on Jane's bicycle. He paid \$4.79 for the brake.

He earned _?_ for his work on the job. He charged Jane _?_.

2. Jed worked 15 minutes fixing Bill's fountain pen. He spent 35¢ for a new pen point and 7¢ for a rubber tube.

He earned _?_ for his work on the job. He charged Bill _?_.

3. Alice "baby sits" with her sister's baby every Saturday from 9:30 A.M. until 1:00 P.M. Her sister pays her 30¢ an hour.

How much does Alice earn each Saturday?

4. Each week last summer Pat earned \$.75 for cutting Mrs. Cook's grass, \$2.60 for delivering newspapers, and \$1.50 for caring for a neighbor's chickens.

What were Pat's total weekly earnings? How much did he earn during his 10 weeks' vacation?

5. Peter has a roadside stand. He buys honey from Mr. Smith at \$1.40 a gallon and sells it for 50¢ a quart. He pays 8¢ apiece for jars for the honey.

How much does Peter make on a gallon of honey? on 10 gallons?

6. Nancy gathers water cress and sells it for 12¢ a bunch. She sells a total of 28 bunches.

How much money does she earn?

Spending and saving

1. Below is James's account book. What was his income during the week of September 20?

2. How much did James spend that week for his own pleasure? for necessities? for the good of others? How much did he save?

Do you think James used his money wisely? Why?

3. Do you have an allowance? Do you earn money?

What do you do with your money? Do you save some of it? What are you saving it for?

4. If you received an allowance of 50¢ per week, how would you plan to spend it so as to do the most with your money?

Compare your plan with those of your classmates. Let the class decide whose plan offers the wisest use of the money.

5. Bart is saving 25¢ a week to buy a camera for $6.25.

How many weeks will it take him to save $1.00? $6.00? $6.25?

6. Pete wants corduroy slacks that cost $5.19. He has saved $3.75 for them. His mother says she will give him the rest. How much will she need to give him?

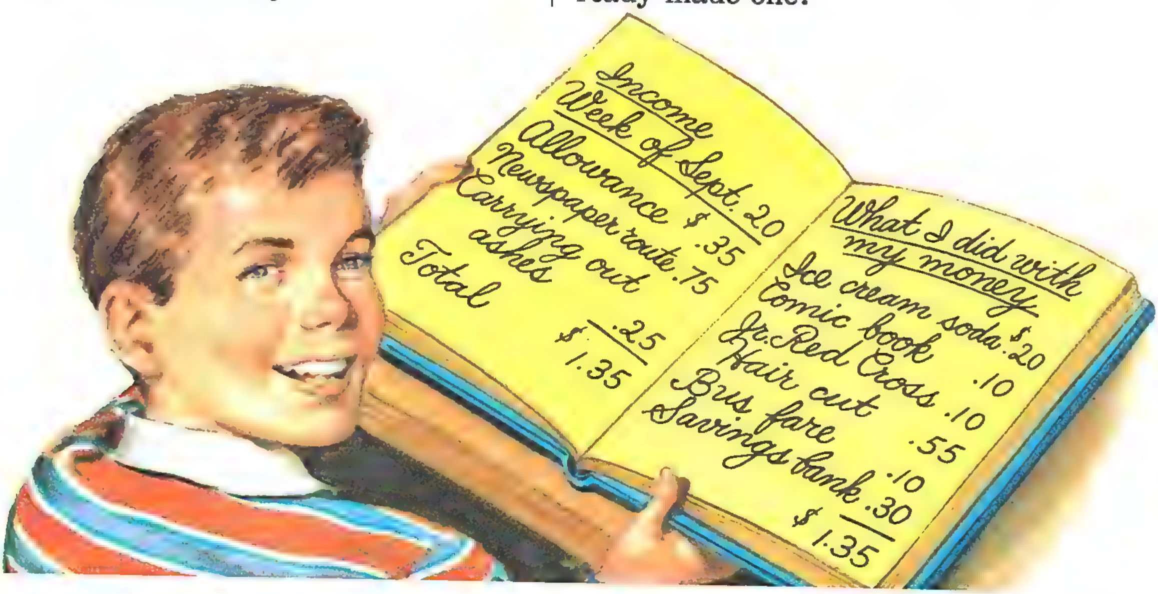
7. Peggy has saved $5.13 in the School Savings Bank and she has fourteen 25-cent Savings Stamps.

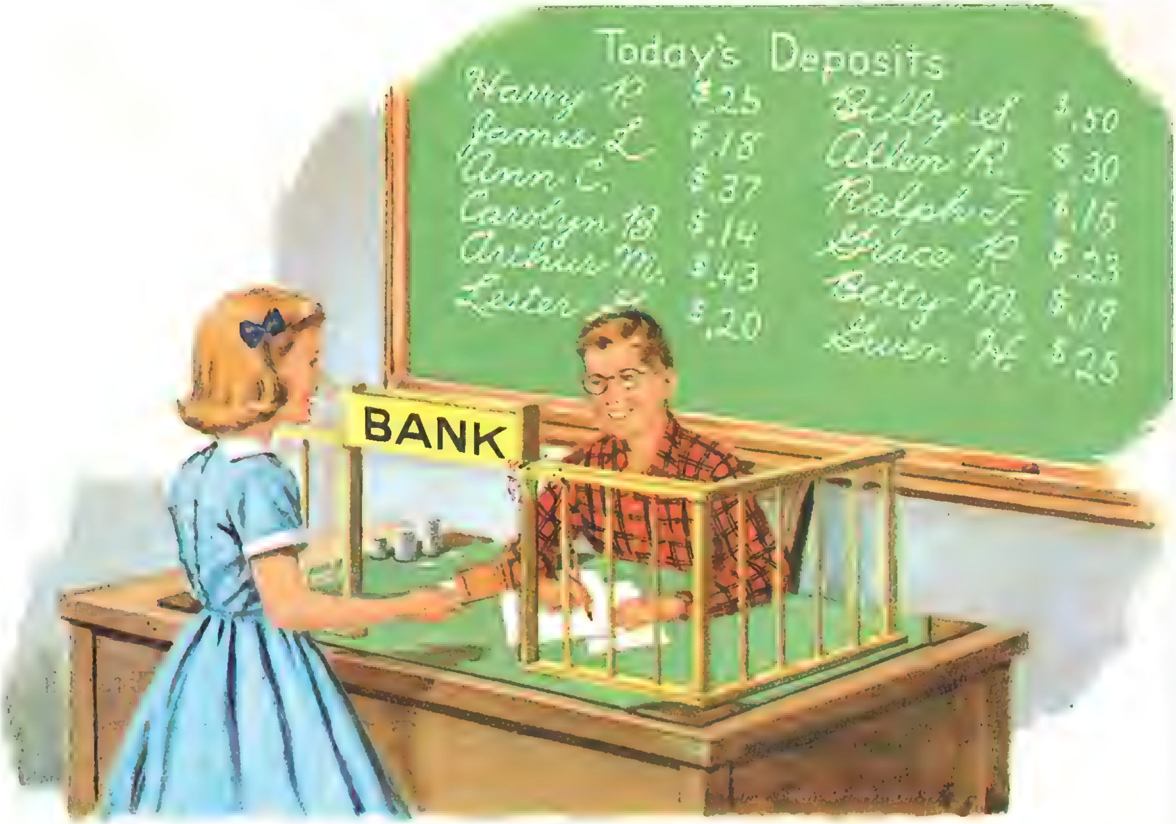
How much money has she saved all together?

8. Mary Lee wanted a bathing suit. A ready-made one cost $2.79.

She bought a bathing suit pattern for 25¢ and material for 89¢, and made the bathing suit herself.

How much did she save by making a suit instead of buying the ready-made one?





1. The pupils in McKinley School save their money in the school bank. How much have the pupils in Miss Carter's room put in the bank today?

2. Find the total amount of deposits of the boys; of the girls. Did the boys or the girls deposit more today?

3. Ann C. had $3.28 in her bank account. How much did she put in today? How much has she in the bank now?

4. Harry P. earned 63¢ this week. How much of it did he put in the school bank? How much did he keep out to spend?

5. Lester G. is putting 20¢ in the school bank each week. There are 40 weeks of school. How much will he save in all?

6. Kit is saving to get a bicycle that costs $43. She has $17.64. How much more does she need?

7. David saved $12.32. He spent $9.49 for a radio. How much money did he have left?

8. Rose has 24 ten-cent Savings Stamps and 18 twenty-five-cent Savings Stamps. How much are her stamps worth all together?

9. Paul has saved 1307 pennies. They equal _?_ dollars and 7 cents.

UNIT 2

Meaning and use of numbers to billions
Round numbers

Machines that do arithmetic

1. Have you ever watched a cash register work? Would you know how to "ring up" a sale?

Can you explain to the class how the *amount of sale* is shown on the cash register?

Try to visit a store to see how to work a cash register.

2. Does a cash register add, subtract, multiply, or divide?

3. Look at the adding machine at the bottom of the page. Peter's father uses one just like it in the office where he works. Sometimes he lets Peter add on it.

Have you ever seen an adding machine? Can you explain to the class how to use one?

4. These adding-machine keys show $555,555.55:

How do the keys show where the comma and the cents point should be?

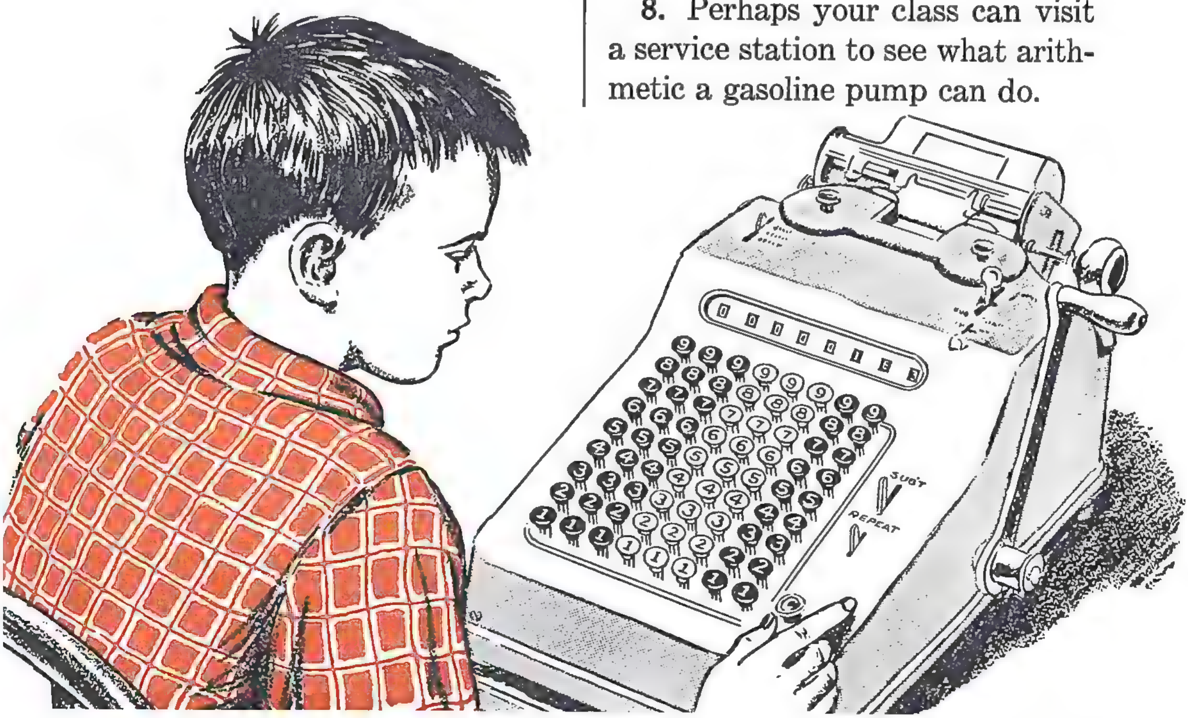
5. Which buttons would you press to add these amounts?

$.15	$ 1.74	$ 24.67
$.06	$ 2.03	$ 430.29
$.70	$14.90	$3,853.74

6. Is each 8 on the adding machine worth 10 times as much as the 8 to the right of it?

7. Is each 6 worth $\frac{1}{10}$ as much as the 6 to the left of it?

8. Perhaps your class can visit a service station to see what arithmetic a gasoline pump can do.



Our number system

1. In our number system we use 10 *figures* or *digits:* 1, 2, 3, 4, 5, 6, 7, 8, 9, and 0. With these we can write any number.

In the number 234, the 4 is in ones place and stands for 4 × 1. The 3 is in tens place and stands for _?_ × 10. The 2 is in hundreds place and stands for _?_ × 100.

200
30
4
234

2. How does this chart teach that the position of a digit in a number shows its value?

3 millions → 3 × 1,000,000
3 hundred thousands → 3 × 100,000
3 ten thousands → 3 × 10,000
3 thousands → 3 × 1,000
3 hundreds → 3 × 100
3 tens → 3 × 10
3 ones → 3 × 1

3,333,333

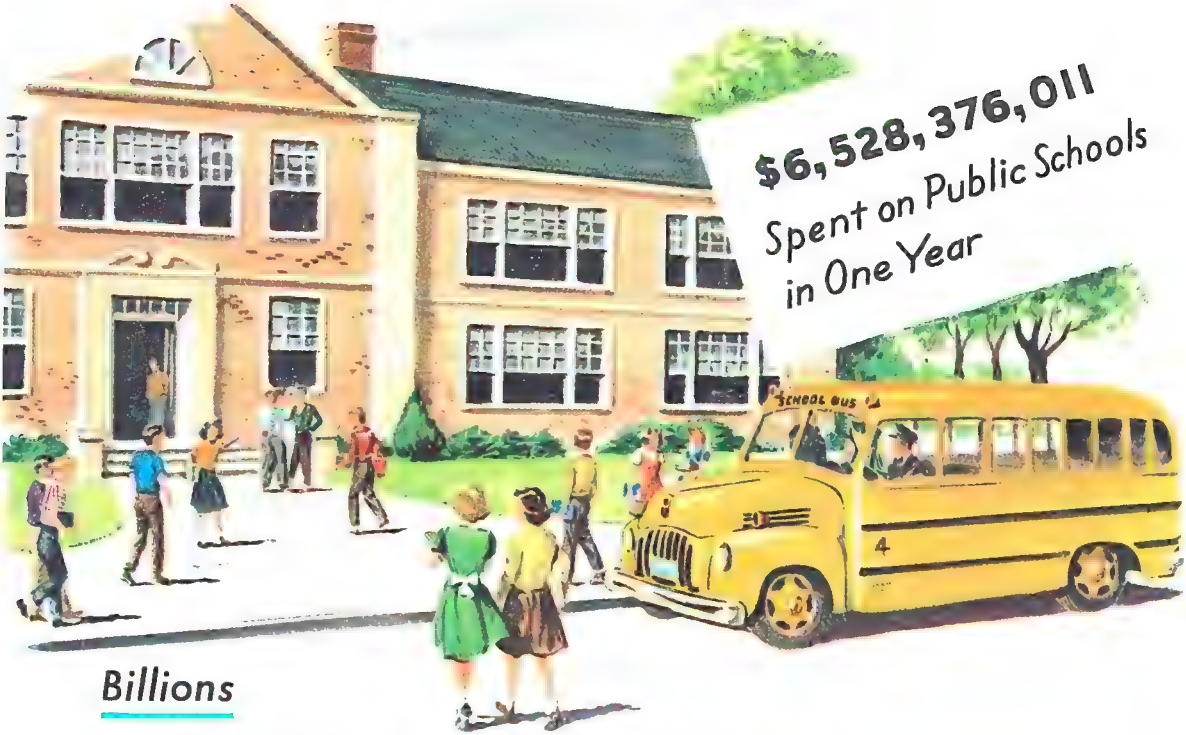
3. The chart in Ex. 2 shows that:

- the value of the 3 in tens place is 10 times as large as the value of the 3 in _?_ place.
- the value of the 3 in hundreds place is _?_ times as large as the value of the 3 in tens place.
- the value of any 3 in the number is 10 times as large as the value of the 3 to the _?_ of it.

4. Here is a study of the number 2,467,035. Write a similar study for the numbers 48,206 and 156,084.

In 2,467,035:

the 2 stands for 2 × 1,000,000 →	2,000,000
the 4 stands for 4 × 100,000 →	400,000
the 6 stands for 6 × 10,000 →	60,000
the 7 stands for 7 × 1,000 →	7,000
the 0 stands for 0 × 100 →	0
the 3 stands for 3 × 10 →	30
the 5 stands for 5 × 1 →	5
	2,467,035



Billions

The number shown in the picture above is read: 6 *billion,* 528 million, 376 thousand, eleven.

1. Does the diagram below help you understand the number in the picture?

billions
millions
thousands
ones

6 , 528 , 376 , 011

2. A number like 3258705493 is more easily read if commas are used to separate the ones, thousands, millions, and billions, like this: 3,258,705,493. Explain how the commas are placed.

Now read the number. It is a *10-place,* or *10-digit,* number.

3. Copy these numbers on the board. Place commas. Read.

11101101	7007070700
10110101	7070707000

4. What is the largest 3-place, or 3-digit, number? the smallest 4-digit number? the largest 6-digit number? the smallest 6-digit number? the largest 7-digit number?

5. One million is a _?_-digit number. One million is written with a 1 and _?_ zeros after it.

6. One billion is a _?_-digit number. It is written with a 1 and _?_ zeros.

7. Make a bulletin-board collection of clippings that contain large numbers. Discuss the numbers.

How large is a billion?

$10 \times 10 = 100$
$10 \times 10 \times 10 = 1{,}000$
$10 \times 10 \times 10 \times 10 = 10{,}000$
$10 \times 10 \times 10 \times 10 \times 10 = 100{,}000$
$10 \times 10 \times 10 \times 10 \times 10 \times 10 = 1{,}000{,}000$
$10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10{,}000{,}000$
$10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 100{,}000{,}000$
$10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 1{,}000{,}000{,}000$

1. Study the chart above. See how many different things about our number system you can learn from it.

2. Sue said that 1,000 million is a billion. Multiply a million by 1,000 to check her statement.

Sue gave this illustration of the meaning of a billion: If 1,000 persons each have $1,000,000, then all together they have $_?_.

Give another illustration of this meaning of a billion.

3. How many cities with a population of a million persons would it take to make a billion persons?

4. Mary figured that $100 \times 100 \times 100$ is a million. Check her idea. Illustrate it.

5. The population of our country is about 150 million. How much money would we have if each person had $1? $10?

6. Bill said that $1{,}000 \times 1{,}000 \times 1{,}000$ is a billion. He gave this illustration:

- There are 1,000 nails in a bag.
- There are 1,000 of these bags of nails packed in a carton.
- There are 1,000 cartons of the nails at a factory.
- In all the cartons there are $1{,}000 \times 1{,}000 \times 1{,}000$ nails, or a billion nails.

Give another illustration of this meaning of a billion.

7. Are there more than a billion persons living in the world today? Maybe you can find the answer to this question in your library.

8. A distance equal to a million inches would stretch for almost 16 miles, but a distance equal to a billion inches would reach almost _?_ miles.

16,000 miles is about $\frac{2}{3}$ of the distance around the earth.

Round numbers

1. Steve estimated the sum of these three amounts by thinking, "10 dollars and 30 dollars are 40 dollars, and 35 dollars are 75 dollars."

\$10.23
29.65
35.17

He was *rounding off* each amount *to the nearest dollar.* Find the *exact* sum.

When you round off to the nearest dollar, you think of any amount of money from \$9.50 to \$10.49 as being \$10.

2. Round off these amounts of money to the nearest dollar:

\$19.76	\$9.95	\$99.85
\$39.80	\$10.47	\$100.21
\$18.40	\$19.80	\$1000.18

3. When Bill returned home from a 2987-mile auto trip, he said: "We drove 3 thousand miles during our trip." Bill was rounding off *to the nearest thousand.*

Any number from 2,500 to 3,499 when rounded off to the nearest thousand, is thought of as 3,000.

4. Round off each of these numbers to the nearest thousand; to the nearest hundred:

2995	4568	7032	99,820
3045	5475	47,659	100,317
9763	8320	40,652	909,009

5. A radio commentator announced that the population of the United States is now 160 million. He was rounding off to the nearest million.

Round off each of these numbers to the nearest million:

149,975,621	987,659
150,270,512	1,012,110
849,980,256	500,400,000
850,276,194	499,850,000

6. Estimate to the nearest dollar the sum of \$10.40, \$30.12, and \$19.84.

7. Estimate to the nearest dollar the difference between \$29.80 and \$18.18.

8. Joy read in *The Evening Star,* "The housing project will cost $2\frac{1}{2}$ million dollars."

Another newspaper, *The Eagle,* stated, "The city will spend \$2,500,000 on the housing project."

Prove that the amounts mentioned in the two papers are equal.

9. Write each of the following amounts in another way:

a quarter million	$3\frac{1}{2}$ million
$2\frac{1}{4}$ million	$\frac{3}{4}$ million
250,000,000	$\frac{1}{2}$ billion
2,500,000	$\frac{1}{4}$ billion

Some interesting large numbers

1. Tom wrote the number shown in the picture this way: 55,301,000,000. He read it this way: _?_ billion, _?_ million.

2. Tom looked at the picture and said that the number of eggs produced this year is rounded to millions. Do you agree?

Write each of the numbers in Exs. 3–5, using figures only.

3. Our farmers have been producing as much as 9,378 million pounds of beef in a year.

4. Recently our yearly corn crop was estimated to be 2,400,952 thousand bushels.

5. Our record wheat crop was 1,367 million bushels.

6. If you had to teach someone the meaning of a thousand, how would you do it? How would you teach the meaning of a million? of a billion?

7. If you started with a million and subtracted 1,000 over and over again, how many subtractions could you do?

8. If you started with a billion and subtracted 1,000,000 over and over again, how many subtractions could you do?

9. Begin with 100,000. Count by 100,000's to a million.

10. A century is 100 years. How many centuries are there in a million years?

UNIT 3

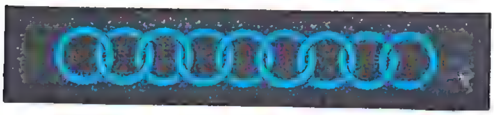
Meaning and use of addition. Practice for speed and accuracy. Estimating sums

Thinking about addition

Miss Taylor's class was discussing "What every sixth grader should know about addition."

▶ Peter said, "We should know that adding means putting groups of things together to make a larger group.

"If I fasten these three pieces of chain together into one long piece, I am adding 4 links and 3 links and 2 links. My answer is _?_ links. Look at my chain now."



Give another illustration of Peter's idea.

▶ Ann said, "I like Peter's idea. But you don't have to have groups of *things* to add. You can put *numbers* together.

"When we put 4, 3, and 2 together, we get 9. 9 is as many as 4 and 3 and 2. 9 is the sum of 4, 3, and 2."

How does Ann's idea differ from Peter's?

▶ Sue said, "We should know that adding zero to a number doesn't change the number."

Illustrate Sue's idea.

▶ Bill said, "We should know the facts of addition, such as '7 and 6 are 13' and '6 and 7 are 13'.

"I think there are 100 of these addition facts."

Can you figure out what those 100 facts are?

▶ Mary said, "If we forget a fact such as $8 + 5 = 13$, we need to know how to think it out.

"To find $8 + 5$, I see in my mind these two groups of dots:

8 5

"To find the sum, I regroup the dots to make a ten and _?_ more.

"So I see that $8 + 5 = 1$ ten and 3 ones, or 13."

Give other illustrations of Mary's idea.

▶ Tom suggested, "We should know about carrying in addition. To add 28 and 17, I see that 7 ones and 8 ones are 15 ones.

"Then I regroup the 15 ones into 1 ten and 5 ones. The 5 ones stay in the ones column. I carry the 1 ten to the tens column.

$$\begin{array}{r} 28 \\ 17 \\ \hline 45 \end{array}$$

"1 ten + 2 tens + 1 ten is 4 tens."

Give illustrations of Tom's idea.

▶ Harry talked about *adding by endings.* He wrote the examples below on the blackboard. What was his idea? Give other illustrations of his idea.

4	14	34	84	134
+ 3	+ 3	+ 3	+ 3	+ 3
7	17	37	87	127
+ 6	+ 6	+ 6	+ 6	+ 6

Make up a rule for doing the examples in the first row; in the second row.

▶ To find the sum of 64 and 32 mentally, Alfred thinks:

"64 + 30 = 94; 94 + 2 = 96."

Give other illustrations of Alfred's idea.

▶ Nina said, "An addition isn't complete until it has been checked. When I do an addition, I add down. I check by adding up."

487
85
324
896

Use this addition to illustrate Nina's method of checking.

▶ George said that he checks an addition this way: ⟶

487
85
324
16
18
7
896

Can you explain his work?

Give other illustrations of George's method of checking.

▶ Allan checks a long addition as shown in this box. The sum of the first 3 numbers is _?_. The sum of the next 3 numbers is _?_. The total sum of all 6 numbers is _?_.

286	
28	
385	699
904	
281	
95	1280
	1979

Give other illustrations of Allan's method of checking.

▶ June always checks an addition by estimating to see if the sum is sensible.

To check Allan's example above, she estimates, "300 + 400 + 900 + 300 + 100 = 2000; so 1979 is a sensible answer." Explain Jane's estimation.

▶ Billy said it is important in an addition to add ones to ones, tens to tens, hundreds to hundreds, and so on.

Write these in a column and add: 37 + 9 + 26 + 304 + 926.

How does your work illustrate what Billy meant?

▶ Paul said that in adding money it is important to remember where to write the cents points and the dollar signs.

\$4.72
.95
6.32
\$11.99

Use this addition to illustrate what he had in mind.

How well can you add?

Try to write the correct answers to each test in 4 minutes. (Use folded paper in Tests I, II, and III)

TEST I

1.	2.	3.	4.	5.	6.
84	68	99	624	436	692
37	72	20	609	94	500
76	43	45	783	62	76
40	39	48	365	728	8
85	51	54	832	507	47

TEST II

1.	2.	3.	4.	5.
427	938	$64.50	$ 5.15	$602.65
491	274	7.23	73.10	47.49
773	165	10.67	9.89	25.23
846	307	9.08	7.50	300.50
538	320	.79	12.49	70.37

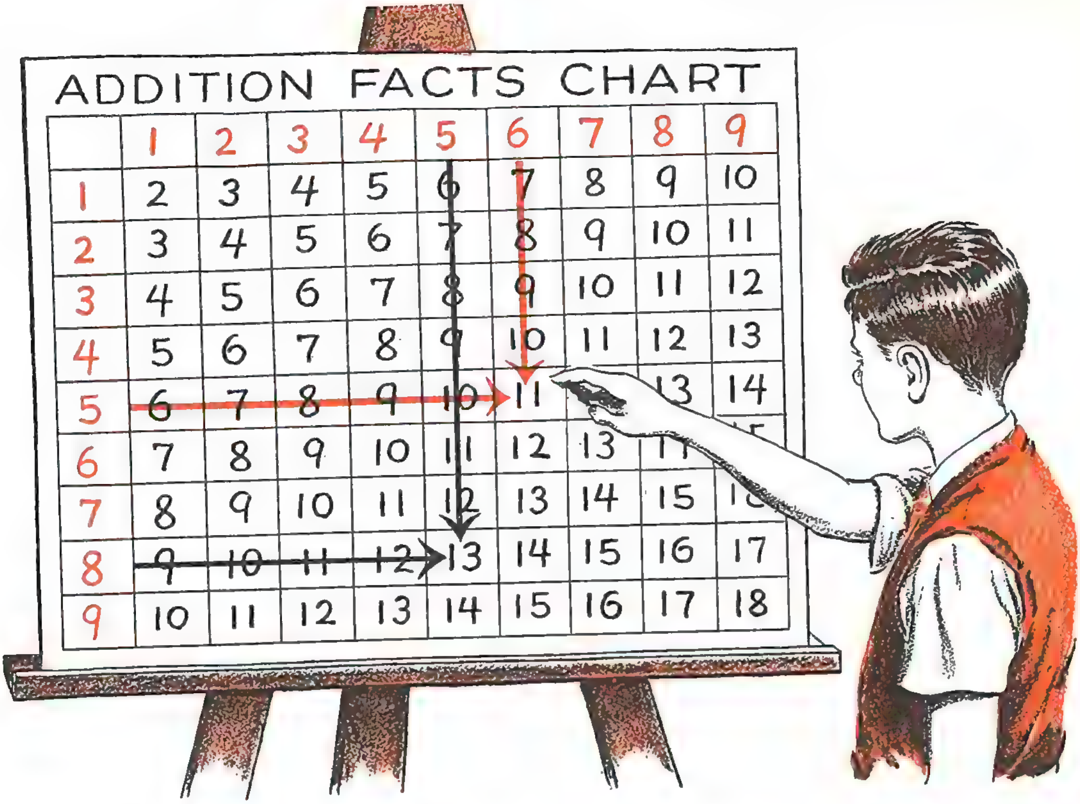
TEST III

1.	2.	3.	4.	5.
773	824	$75.60	$ 2.89	$902.75
289	36	2.80	42.76	68.63
663	589	3.98	5.37	29.84
276	74	.46	8.63	9.64
304	63	57.33	.75	543.20
768	987	.75	79.12	75.00

TEST IV *Copy in columns, add, and check:*

1. 89 + 278 + 65 + 483 + 92
2. 76 + 79 + 286 + 9 + 463 + 75
3. \$6.43 + \$.43 + \$5 + \$6.25
4. \$42 + \$2.75 + \$.83 + \$5

If you did not get a perfect score on each test, study pages 15–19; then take the above tests again. Practice until you can make a perfect score on each test in 4 minutes.



Addition Facts Chart

Norman says, "5 and 6 are 11." He has drawn red arrows on his chart to show how he uses it to check his answer of 11.

1. What 2 addition facts do the black arrows help you check?

2. On the chart find all the addition facts whose sums are 10; 11; 12; 13; 14; 15; 16; 17; 18.

3. Without looking at the chart, can you give the addition facts asked for in Ex. 2?

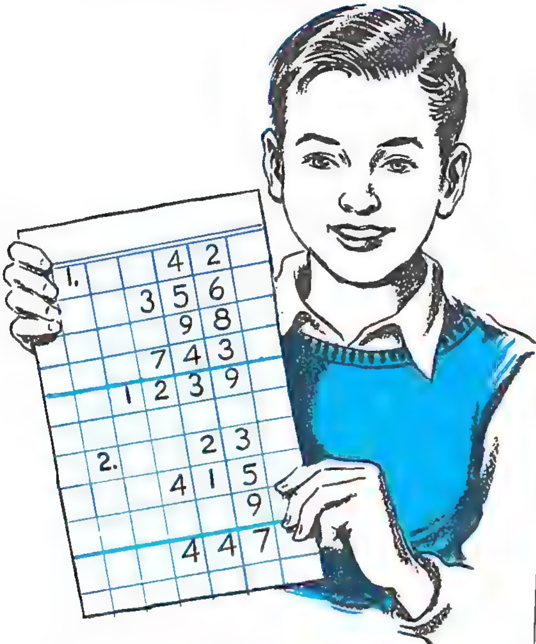
4. There are 17 facts on this chart in which 6 is one of the numbers being added. What are they?

5. On the chart find 17 facts in which 8 is one of the numbers being added.

Tell these sums. Then use the chart to check each answer.

	a	*b*	*c*	*d*	*e*	*f*
6.	9 5	8 6	7 4	7 9	6 7	5 2
7.	9 8	5 7	6 4	4 9	3 8	8 7
8.	5 4	5 6	3 6	8 4	3 7	8 5
9.	9 3	6 4	5 2	2 9	4 3	6 9

Addition practice



Tom was having trouble keeping his columns straight when he wrote down an addition.

He got some graph paper that was ruled in quarter-inch squares. See how he used it.

Are his additions correct?

Copy, add, and check. (If necessary, use Tom's suggestion for keeping columns straight.)

1. 25 + 762 + 34 + 905
2. 87 + 9 + 423 + 56
3. 79 + 2462 + 543 + 7
4. 876 + 247 + 1023 + 95
5. 683 + 45 + 706 + 16
6. \$.46 + \$.87 + \$2.43 + \$.95
7. \$10.75 + \$3.94 + \$6 + \$.72
8. \$12.32 + \$4.67 + \$5 + \$.05
9. \$4.62 + \$.73 + \$8.25 + \$10
10. \$12.72 + \$9.46 + \$.75 + \$.09

Write the number that is:

11. 200 more than 507.
12. 70 more than 632.
13. 1000 more than 1084.
14. 10 more than 2795.
15. 15 more than 2795.

What number comes next?

16. 9, 16, 23, 30, __?__
17. 75, 95, 115, 135, __?__
18. 1242, 1642, 2042, 2442, __?__
19. 27, 42, 57, 72, __?__

20. Tell the answers to the addition facts on page 305. Then try to write all the answers correctly on folded paper.

Study any facts you miss and take the test again.

Keep practicing until you can write all the answers correctly in 4 minutes.

Addition practice

93		
103		addends
196		
392		sum

1. In the addition example at the right, name the *addends*. Name the *sum*.

2. If the addends are 17 and 8, the sum is __?__.

3. Addends are 30, 35, and 40; sum is __?__.

4. Add 6 to each number below. Add 7. Add 8. Add 9.

89 91 55 73 37 64 46

5. Add 10 to each number in Ex. 4. Add 20. Add 30.

6. Add 11 to each of the numbers in Ex. 4; add 21; 31; 41; 12; 22; 32; 13; 23; 43.

Add and check:

	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*
7.	3	6	7	2	4	3	8	6
	5	3	2	5	5	6	6	7
	7	5	4	7	9	6	7	8
	9	3	5	8	7	7	8	7
	5	5	4	9	8	9	7	5
	7	9	6	4	8	6	5	4

8.	92	57	32	64	44	42	67	58
	78	84	86	76	55	84	62	43
	58	47	53	97	78	89	49	64
	75	78	65	36	59	97	99	98
	46	73	45	75	94	85	73	65

9. Chester paid $35.95 for a violin, $8.79 for a violin case, and $7.49 for a bow. How much did he spend in all?

10. Find the sum of 425, 682, 75, and 803.

11. Tom bought a pair of ice skates for $5.98, a pair of wool socks for $.89, a hockey stick for $1.69, and a pair of ankle supports for $1.09.

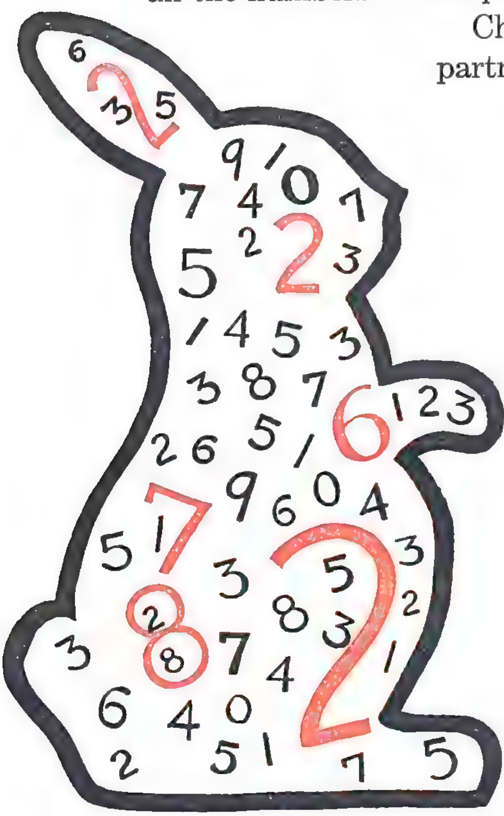
How much did Tom spend all together?

Addition practice

Add. Write the answers on folded paper. Check your work.

	a	b	c	d	e
1.	82	73	149	84	$3.45
	359	438	337	43	.63
	67	58	58	496	.94
	585	379	295	565	6.89
2.	3278	628	6578	$57.59	$26.93
	557	3698	237	4.35	35.68
	1667	589	958	26.84	4.88
	2693	5667	5744	18.59	47.46
	3154	7340	675	23.74	6.32

Tom and Dick won a contest by finding the correct sum of all the numbers in this picture.



Choose a partner. See if you and your partner can do as well as Tom and Dick.

The way they found the sum is shown below. They checked each other's work at each step.

▶ They counted the number of 1's and then wrote down that number.

▶ They counted the number of 2's. They multiplied 2 by that number. Why?

▶ They added that answer to the number of 1's. Why?

▶ They counted the number of 3's. What did they do next?

▶ Tell how you think they finished the contest.

▶ They did not do anything with the zeros in the picture. Why not?

Adding mentally — estimating

1. Which of these ways of adding 37 and 28 mentally do you like best?

- $37 + 28 = 30 + 20 + 7 + 8 = 65$
- $37 + 28 = 37 + 20 + 8 = 65$
- $37 + 28 = 37 + 30 - 2 = 65$

Add mentally. Use the method that is easiest for you.

	a	*b*	*c*
2.	$40 + 10$	$36 + 12$	$27 + 43$
3.	$50 + 25$	$37 + 18$	$38 + 25$
4.	$92 + 40$	$58 + 14$	$99 + 18$
5.	$30 + 25$	$67 + 23$	$97 + 64$
6.	$90 + 62$	$89 + 13$	$90 + 27$

7. Elmer added 256 and 34 by thinking: $256 + 30 = 286$; $286 + 4 = \underline{?}$.

Use Elmer's way to add:

8.	$250+49$	$350+27$	$250+27$
9.	$321+35$	$351+38$	$342+24$
10.	$462+26$	$422+45$	$403+85$
11.	$367+40$	$536+33$	$811+78$
12.	$338+21$	$754+24$	$372+16$
13.	$461+41$	$673+30$	$285+34$

14. Is $298 + 103 + 99$ about 400, 500, or 600? Think: It is about $300 + 100 + 100$, or $\underline{?}$.

15. Is the sum of $489 + 307 + 50$ about 650, 750, or 850?

16. Would you estimate the total cost of a coat at \$12.98, a hat at \$2.98, and shoes at \$4.00 to be about \$18, \$19, or \$20?

17. Check your estimate in Ex. 16 to see how close it was to the exact sum.

First estimate the answer to each of these problems. Then check your estimate to see how close it is to the exact answer.

18. Find the total cost of 3 pairs of woolen socks at 98¢ and a pair of boots at \$3.50.

19. How much is 597 increased by 407?

20. In Freemont School there are 203 fourth graders, 198 fifth graders, and 175 sixth graders.

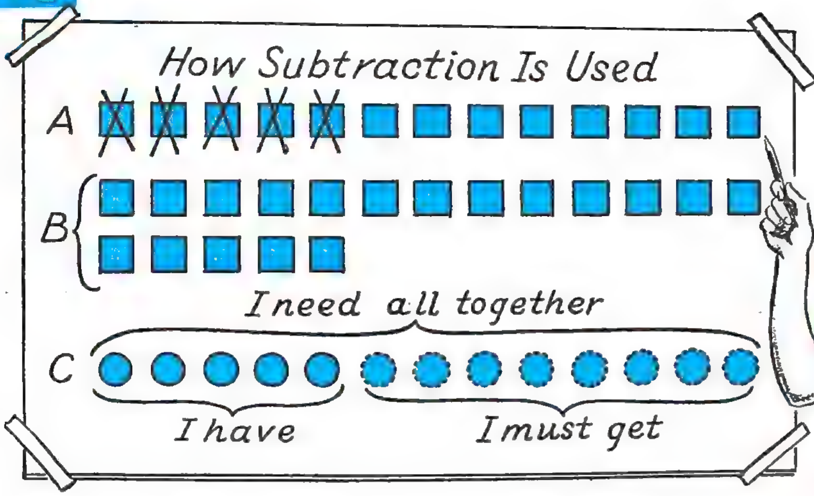
How many pupils are there in the 3 grades?

21. On an automobile trip, Ben and his father traveled 395 miles on Monday, 407 miles on Tuesday, 350 miles on Wednesday, and 401 miles on Thursday.

How far did they travel in the four days?

UNIT 4

Meaning and use of subtraction. Practice for speed and accuracy. Estimating answers



Thinking about subtraction

To show "what every sixth grader should know about subtraction," Joyce made this chart.

▶ Joyce said, "Picture A shows that *subtracting* is taking a group of things away from a larger group.

"I think of the 13 blocks as a group of 5 blocks and a group of 8 blocks.

"I take the 5 blocks away from 13 blocks. I am subtracting 5 blocks from 13 blocks. I have _?_ blocks left."

Give problems that illustrate the use of subtraction in Picture A.

▶ Peter said, "Picture B shows that subtraction is used to compare 2 groups to find how much larger or smaller one group is than another."

Picture B shows that:

- 13 blocks is _?_ more than 5 blocks.
- 5 blocks is _?_ less than 13 blocks.

Give problems that illustrate the use of subtraction in Picture B.

▶ John said, "Picture C shows that if I have 5¢ and want to get enough more to make 13¢, I break up the 13¢ into a group of 5¢ and a group of 8¢.

"I subtract the 5¢ I have from the 13¢ I need, and find I must get _?_¢ more."

Give problems that illustrate the use of subtraction in Picture C.

▶ Kit said, "When I subtract 9 from a number, I just subtract 10 and go up one." Illustrate.

▶ Ann said, "We should know how to discover a subtraction fact we have forgotten.

"If I forget that $14 - 6 = 8$, I can group the 14 into 10 and 4, like this:

1 2 3 4 5 6 7 8 9 10
1 2 3 4

"Then to take away 6, I take away the group of 4 and a group of 2, like this:

1 2 3 4 5 6 7 8 ~~9~~ ~~10~~
~~1~~ ~~2~~ ~~3~~ ~~4~~

"I think: $14 - 6 = 10 - 2 = \underline{\ ?\ }$"

Give other illustrations of Ann's idea.

▶ Jack said, "Ann's idea is good, but we really should *know* all the subtraction facts and not have to think them out every time we use them."

Why is Jack's suggestion a good one?

▶ Alice said, "I suppose everybody knows that when zero is subtracted from a number the answer is that number." Illustrate Alice's idea.

▶ Russell said, "Of course we all know that any number minus itself equals zero." Illustrate Russell's idea.

▶ Bill said, "We should all know about borrowing. In subtracting 28 from 62, we think this way:

$$\boxed{\begin{array}{r} 62 \\ -\ 28 \\ \hline 34 \end{array}}$$

- "We can't take 8 from 2.
- "We borrow 1 of the 6 tens, and change it into 10 ones.
- "We put the 10 ones with the 2 ones. Then we have 12 ones."

Tell how Bill would finish the subtraction.

▶ James said, "You are right, Bill, but I think of that subtraction like this:

- "We can't take 8 from 2.
- "We regroup the 62 (6 tens and 2 ones) into 5 tens and 12 ones."

Tell how James would finish the subtraction.

Give other illustrations of Bill's and James's ways of thinking in subtraction with borrowing.

▶ Katherine said, "We ought to discuss checking subtraction. Let's check Bill's example.

"We add the 34 and the 28. The sum should be 62; if it isn't, look out!"

Give several illustrations of checking subtraction by Katherine's method.

Can you think of other ways to check subtraction?

Testing yourself in subtraction

Time yourself when you take these subtraction tests. Try to write the answers to each test correctly in 4 minutes. (Use folded paper in Tests I, II, and III.) Check each answer.

TEST I

1.	2.	3.	4.	5.
456	509	763	500	998
283	293	94	298	248

TEST II

1.	2.	3.	4.	5.
8438	6573	17472	18000	\$126.55
754	868	7816	6593	68.59

TEST III

1.	2.	3.	4.	5.
7059	16210	90340	50800	\$1850.00
3673	6935	20768	989	868.79

TEST IV

1. 876 – 432 **2.** 2468 – 1283 **3.** 2875 – 2096 **4.** \$5 – \$2.76

5. 894 – 38 **6.** 2000 – 1987 **7.** 1909 – 995 **8.** \$12 – \$3.85

TEST V

1. Columbus discovered America in 1492. How many years ago was that?

2. There are 320 pages in Bob's book, *Famous Pilots.* Bob has read 187 pages.
He has _?_ more pages to read.

3. Jean has \$12.90. How much more must she save to buy a United States Savings Bond for \$18.75?

4. How much change will Peter get from a ten-dollar bill if he buys a fielder's baseball glove for \$2.69?

If you could not do each of the above tests correctly in 4 minutes, study the subtraction review that follows on pages 23 to 26. Then take the above tests again. Practice until you can make a perfect score on each test in 4 minutes.

Subtraction helps

Below are some "Subtraction Helps" the pupils in one sixth-grade class gave each other:

1. Judy said, "I like to subtract 98 from a number. I take away 100; then I put back 2." Explain.

• Tell how Judy would think in doing these subtractions:

$$\begin{array}{rrrr} 450 & 380 & 700 & 957 \\ \underline{-\ 98} & \underline{-\ 95} & \underline{-\ 197} & \underline{-\ 296} \end{array}$$

• Make up a list of five other examples to work by Judy's method. Work your examples mentally.

2. John said, "When I subtract 238 from 600, I see 600 as 60 tens. I take one of the 60 tens and change it into 10 ones. How do I show the other 59 tens in the minuend?

$$\boxed{\begin{array}{r} 5\ 9\ 10 \\ \cancel{6}\,\cancel{0}\,\cancel{0} \\ \underline{2\ 3\ 8} \end{array}}$$

• Copy and work John's subtraction above.

• Explain what he has done in each of these subtractions; then copy and work them.

$$\begin{array}{rrr} 5\ 9\ 10 & 8\ 9\ 9\ 10 & 5\ 9\ 9\ 16 \\ \cancel{6}\,\cancel{0}\,\cancel{0} & \cancel{9}\,\cancel{0}\,\cancel{0}\,\cancel{0} & \cancel{6}\,\cancel{0}\,\cancel{0}\,\cancel{6} \\ \underline{2\ 4\ 5} & \underline{6\ 2\ 5\ 4} & \underline{2\ 8\ 7\ 8} \end{array}$$

• Make up five other examples to work by John's method.

3. Lois said, "Last year, I wrote Helping Numbers above the minuend to help me with borrowing in subtraction: ⟶

$$\boxed{\begin{array}{r} 7\ 9\ 13 \\ \cancel{8}\,\cancel{0}\,\cancel{3} \\ \underline{-\ 2\ 5\ 7} \\ 5\ 4\ 6 \end{array}}$$

"Now, I *think* the Helping Numbers instead of writing them."

• Try to do these subtractions without writing Helping Numbers.

$$\begin{array}{rrrr} 287 & 605 & 1856 & 6521 \\ \underline{-\ 198} & \underline{-\ 287} & \underline{-\ 676} & \underline{-\ 3876} \end{array}$$

4. Bruce said, "If you know the subtraction facts, any subtraction with a one-figure subtrahend is easy."

• What key fact is used in each of these subtractions?

$$\begin{array}{rrrr} 37 & 78 & 149 & 157 \\ \underline{-\ 4} & \underline{-\ 5} & \underline{-\ 6} & \underline{-\ 5} \\ \\ 51 & 63 & 482 & 155 \\ \underline{-\ 7} & \underline{-\ 5} & \underline{-\ 3} & \underline{-\ 9} \end{array}$$

• Make up a rule for finding the answers in the first row above; in the second row.

5. Tell the answers to the facts on page 306. Then write all the answers on folded paper.

Study any facts you miss, and take the test again. *Keep practicing until you can write all the facts correctly in 4 minutes.*

Subtracting mentally

1. In the subtraction below, name the *minuend;* the *subtrahend;* the answer, or *difference.*

907	minuend
748	subtrahend
159	difference
907	check

2. Explain the check in Ex. 1.

3. Can the subtrahend be as large as the minuend? If it is, what is the answer, or difference?

4. Can the subtrahend be less than the difference? Illustrate.

5. Can the subtrahend and the difference be equal? Illustrate.

6. In the subtraction example in Ex. 1 do you borrow once, or twice?

Can you make up an example in which you have to borrow three times?

7. Find the dictionary definition of minuend, subtrahend, and difference.

8. To find 52 – 14 mentally, Arthur thinks, "52 – 10 = 42; 42 – 4 = 38." How would *you* do Arthur's example mentally?

Use Arthur's method (Ex. 8) to do these subtractions mentally:

	a	*b*	*c*	*d*
9.	52 – 15	104 – 31	592 – 11	1000 – 203
10.	63 – 16	123 – 43	679 – 103	1000 – 305
11.	71 – 23	197 – 56	823 – 118	1000 – 550
12.	84 – 35	200 – 63	900 – 203	1000 – 798

Do these problems mentally. Then check by written subtractions.

13. Tom collects match folders. He has 197 folders, but 25 of them are duplicates. He has only _?_ folders that are all different.

14. George has $57. If he spends $29 for a horn, how much money will he have left?

15. The pupils in Belmont School want to buy a television set that costs $250. They have $70. How much more must they save?

16. Polly bought 100 sheets of colored paper. She has 27 sheets left. She has used _?_ sheets.

Subtraction practice

Subtract. Write the answers on folded paper. Check.

	a	*b*	*c*	*d*	*e*	*f*
1.	426 88	246 95	588 299	610 187	\$6.04 3.77	\$6.64 2.66
2.	300 156	1036 989	1800 869	1554 748	1060 577	2858 986

3. Don't forget the dollar signs and the cents points in these:

a	*b*	*c*	*d*	*e*
\$37.90 – 17.82	\$81.42 – 56.79	\$90.05 – 35.75	\$200.00 – 18.97	\$800.80 – 359.88

Estimating answers in subtraction

1. Would you estimate the difference between 998 and 403 to be about 500, 600, or 700?

2. Would 2,000 – 597 be about 1,600, 1,500, or 1,400?

3. Would 900 – 249 be about 750, 650, or 550?

4. Would the difference between 700 and 298 be about 300, 400, or 500?

5. Marie has a ten-dollar bill. The shoes she wants cost \$4.89.

She estimates she will have about \$6 left if she buys the shoes. Is her estimate correct?

6. Russell has \$4.15. He wants a pea jacket that costs \$9.00.

He estimates he needs to earn a little more than \$5 before he can get the jacket. Do you agree with his estimate?

7. Carl estimated that a man who was born in 1891 and died in 1948 lived about 60 years. Was Carl's estimate close?

8. A fast train's speed was 68 miles an hour. A plane's speed was 200 miles an hour.

Did the plane travel about 140, 130, or 120 miles an hour faster than the train?

Using addition and subtraction

After you solve each problem, check the answer. Be sure it is sensible.

1. Philip had \$13.50 worth of Savings Stamps in his stamp book. He put in another \$.75 worth of stamps.

What was the total value of his savings stamps then?

2. Douglas has \$14.63 in his school savings account. If he takes out \$6.89 to buy a fishing rod, how much will he have left?

3. James collects foreign coins. He has 113 coins, including 37 pairs. He has _?_ different coins in his collection.

4. Arthur's home is heated by an oil burner. On November 1 the oil tank had 512 gallons of heating oil in it.

On December 1 there were only 289 gallons left in the tank. How much oil was used during the month of November?

5. In going to visit her grandfather, Alice traveled 75 miles by train, 378 miles by boat, and 69 miles by bus.

How many miles did she travel all together?

6. Billy has flown 900 miles in an airplane. Martha has flown 643 miles. Billy has flown _?_ miles more than Martha.

7. Gus has a 316-page history book to read. He has read 178 pages. How many more pages does he have to read?

8. A typewriter regularly priced at \$80 was marked down to \$76.29. How much was the price reduced?

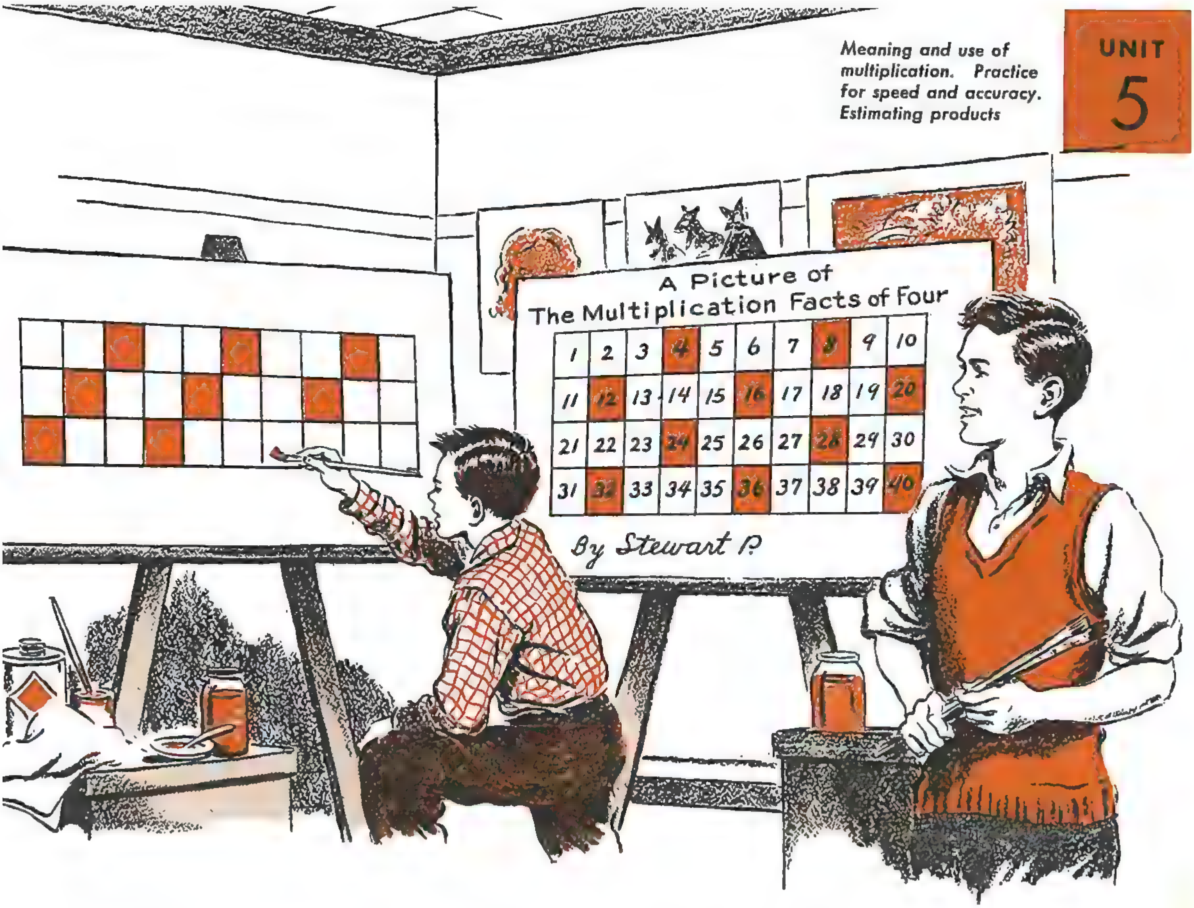
9. Tell the class about your needs for adding and subtracting. Make up some addition and subtraction problems.

10. Fred made up these puzzles. Find the unknown number, "N," in each puzzle. Then make up some "N" puzzles for your class to work.

$$\begin{array}{r} \boxed{N} \\ -\ 17 \\ \hline 34 \end{array} \qquad \begin{array}{r} 50 \\ -\ \boxed{N} \\ \hline 28 \end{array} \qquad \begin{array}{r} 100 \\ -\ \boxed{N} \\ \hline 30 \end{array} \qquad \begin{array}{r} 92 \\ -\ \boxed{N} \\ \hline 47 \end{array} \qquad \begin{array}{r} \boxed{N} \\ -\ 27 \\ \hline 63 \end{array} \qquad \begin{array}{r} \boxed{N} \\ -\ 350 \\ \hline 650 \end{array} \qquad \begin{array}{r} \boxed{N} \\ -\ 27 \\ \hline 313 \end{array} \qquad \begin{array}{r} \boxed{N} \\ -\ 3 \\ \hline 197 \end{array}$$

UNIT 5

Meaning and use of multiplication. Practice for speed and accuracy. Estimating products



Multiplication fact designs

The members of a sixth-grade mathematics club are getting ready for an exhibit. Some of them are making "multiplication fact designs."

Stewart's finished design is shown in the picture.

1. What multiplication facts did Stewart use for his design?

2. Explain how he made the design.

3. Why do you think he made the design 10 squares wide?

4. Look at the picture. What multiplication facts can you see in the design that Jerry is just finishing?

5. Your class may want to make a design for the multiplication facts of each other number from 1 to 9.

Use squared paper. Make each design 10 squares wide.

How many rows of squares will you need for the table of 2's? the table of 3's? 4's? 5's? 6's? 7's? 8's? 9's?

Thinking about multiplication

▶ Peter wrote on the board his idea of the meaning of 6×12. Explain his work. Give other illustrations of his idea.

▶ Patricia said, "Peter used 12 six times as an addend.

"In multiplication we do not call the 12 an addend. We call it the ***multiplicand***.

"The number which tells how many times the 12 is repeated is called the ***multiplier***.

"The answer 72 is called the ***product***. It is like the *sum* in addition."

Explain what Patricia wrote on the board.

▶ Roger said, "I think this way when I find 6 times 12:

"1 group of 12 = 1 ten 2 ones.

"6 groups of 12 = 6 tens 12 ones.

"6 tens 12 ones = 7 tens 2 ones, or 72."

How would Roger think in finding how many there are in:

5 groups of 13?	4 groups of 15?
3 groups of 24?	5 groups of 14?

▶ Polly said, "We could get along without multiplication if we had to. We could always use addition instead of multiplication."

What reply would you make to Polly?

▶ Bill said, "You should *know* all the multiplication facts, such as $7 \times 8 = 56$, $8 \times 8 = 64$, and so on.

"But if you happen to forget how much 9 eights are, you can always figure out the answer:

$$10 \times 8 = 80,$$
$$\text{so} \quad 9 \times 8 = 80 - 8 = 72."$$

Explain Bill's reasoning. How could you find 6 eights? 5 sevens? 4 nines? 7 sixes?

▶ Robert said, "Any number times zero is zero. This addition shows that 3 zeros are zero, or that $3 \times 0 = 0$."

$$\boxed{\begin{array}{r} 0 \\ 0 \\ \underline{0} \\ 0 \end{array}}$$

Use Robert's method to show that $5 \times 0 = 0$; that $8 \times 0 = 0$.

▶ Andrew said, "If you know that $9 \times 8 = 72$, then you know that $8 \times 9 = 72$."

Use Andrew's idea to tell another fact that each fact below teaches:

$6 \times 9 = 54$ $\quad 9 \times 0 = 0$ $\quad 8 \times 6 = 48$

▶ Elmer said, "You multiply to solve problems like these:

• "What is the cost of so many things at the same price for each?

• "How many seats are there in so many rows with the same number of seats in each row?"

Give other illustrations of problems in which you multiply.

▶ Barbara did these multiplications. What is her rule?

$10 \times 25 = 250$ $\quad 10 \times 146 = 1460$

• Barbara said, "To find 20 times a number, I multiply by 2, then by 10." Illustrate Barbara's rule.

• Make up a rule for finding:

$100 \times$ a number $\quad 30 \times$ a number

$200 \times$ a number $\quad 1000 \times$ a number

• Multiply each of these numbers by 20; 40; 100; 300; 1000.

6	32	41	60	121

▶ Al said, "When I find 6×23 mentally, I think:

$$6 \times 20 = 120; \; 6 \times 3 = 18;$$
$$120 + 18 = 138$$

"When I use paper and pencil to find 6×23, I do it this way":

$$\boxed{\begin{array}{r} 23 \\ \underline{\times 6} \\ 138 \end{array}}$$

How does Al's way of doing a multiplication mentally differ from his written way?

Do these mentally. Then copy them and write your work.

	a	*b*	*c*
1.	8×35	9×23	7×35
2.	9×22	8×65	9×53
3.	7×41	4×72	8×62
4.	6×72	9×53	7×62
5.	7×67	8×48	9×64

6. Take the test on page 307.

Multiplying mentally

1. Ed found 8×25 by thinking:

$$8 \times 20 = \underline{?}$$
$$8 \times 5 = \underline{?}$$
$$160 + 40 = \underline{?}$$

2. Bob found 8×25 by thinking this way:

$$4 \times 25 = 100$$
$$\text{So } 8 \times 25 = 2 \times 100 = 200.$$

Bob said he used a "twice as many" rule. What did he mean?

Use Bob's "twice as many" rule to do these multiplications:

3. $8 \times 6 = 48$, so $16 \times 6 = \underline{?}$

4. $7 \times 9 = 63$, so $14 \times 9 = \underline{?}$

5. $9 \times 4 = 36$, so $18 \times 4 = \underline{?}$

6. $8 \times 7 = 56$, so $16 \times 7 = \underline{?}$

7. $7 \times 12 = 84$, so $14 \times 12 = \underline{?}$

8. $9 \times 11 = 99$, so $18 \times 11 = \underline{?}$

You know that $4 \times 25 = 100$. Use this fact to find:

9.	8×25	9×25	11×25
10.	12×25	13×25	14×25
11.	16×25	17×25	18×25
12.	20×25	21×25	22×25
13.	24×25	25×25	26×25

14. Make a rule for doing examples like Exs. 9 to 13.

15. To find 13×26, think:

$$\begin{array}{r} 10 \times 26 = 260 \\ 3 \times 26 = 78 \\ \hline 13 \times 26 = \underline{?} \end{array}$$

Use the method of Ex. 15 to find these products. Can you do them without using a pencil?

16.	12×20	12×24	23×12
17.	13×20	13×24	24×15
18.	14×20	14×24	32×15
19.	15×20	15×24	26×12

20. To find 6×127, think:

$$\begin{array}{r} 6 \times 100 = 600 \\ 6 \times 20 = 120 \\ 6 \times 7 = 42 \\ \hline 6 \times 127 = \underline{?} \end{array}$$

Use the method of Ex. 20 to find these products:

21.	3×125	4×136	6×120
22.	3×131	4×145	6×124
23.	4×135	4×212	6×130

24. Now do Exs. 21 to 23 as written examples, like this: →

$$\boxed{\begin{array}{r} 125 \\ \times 3 \\ \hline 375 \end{array}}$$

25. Would you estimate the cost of 3 pairs of shorts at \$2.98 each to be about \$6, \$9, or \$12?

Understanding multiplication

36	multiplicand
24	multiplier
144	first partial product
720	second partial product
864	product

1. In the multiplication example above, the first *partial product,* 144, is 4 × 36. The second *partial product,* 720, is 20 × 36.

The *product,* 864, is the sum of _?_ and _?_.

2. Can the multiplication in Ex. 1 be done without writing the zero in the second partial product? Illustrate.

3. Check Ex. 1 in as many ways as you can.

4. In the multiplication shown in the box at the right:

3 × 567 is _?_
40 × 567 is _?_
200 × 567 is _?_
243 × 567 is _?_

$$\begin{array}{r} 567 \\ \underline{243} \\ 1701 \\ 22680 \\ \underline{113400} \\ 137{,}781 \end{array}$$

5. In Ex. 4, the multiplier is _?_. It is a 3-place number, and there are _?_ partial products.

6. In Ex. 4, could the one zero in the second partial product and the two zeros in the third partial product be omitted? Why?

7. Copy the multiplicand and multiplier in Ex. 4 and multiply without looking at the book.

▶ MULTIPLICATION TEST

Try to do these multiplications correctly in 7 minutes:

1.	**2.**	**3.**	**4.**	**5.**	**6.**
648	807	506	879	657	\$56.79
56	436	780	809	1200	96

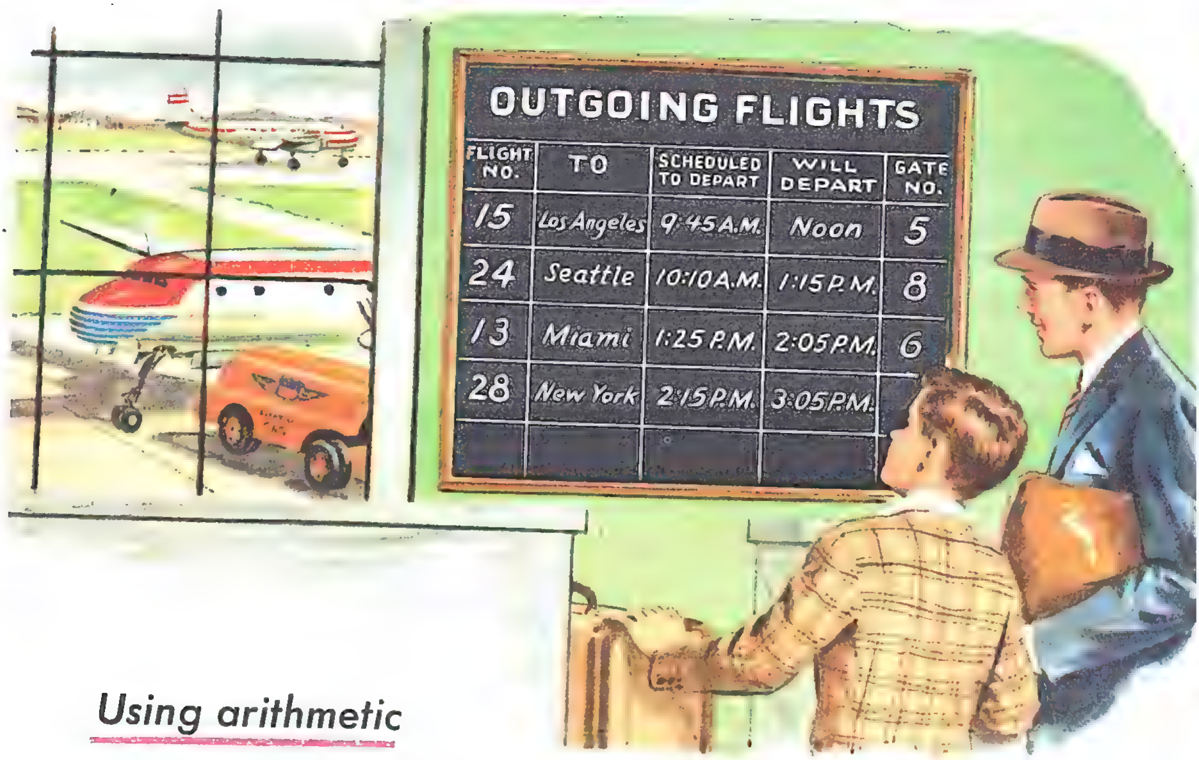
If you could not do all examples of the test correctly in 7 minutes, do Exs. 7 and 8 and then try the test again.

7. Multiply each number below by 9; by 8; 7; 6. Add 2 to each product; add 3; add 4.

7 5 8 2 4 6 9 3

8. Multiply each of the numbers below by 64; by 37; by 58; 904; 286; 50; 600; 7000.

45 73 406 67 85 129 \$9.87 \$5.03 \$4.80 \$7.63



Using arithmetic

1. Harry is flying to Los Angeles. All planes are late today because of foggy weather. How late will his plane be in leaving? How late will each of the other planes be?

2. Steve has charge of collecting lunch money from Miss Blake's class each week. A pupil may order either one of these:

Sandwich and milk	\$.18
Hot lunch	\$.28

Make a table to show how much Steve should collect from a pupil who places either of the above orders for 1, 2, 3, 4, or 5 days.

3. Vincent sold 24 dozen eggs at 55¢ a dozen. How much money did he get for them?

4. To find the cost of 25 five-cent pencils, Bob and Dick used the two ways shown below. Whose way would you use? Why?

Bob

$$\begin{array}{r} 5¢ \\ \times\, 25 \\ \hline 25 \\ 10 \\ \hline 125¢ = \$1.25 \end{array}$$

Dick

$$\begin{array}{r} 25 \\ \times\, 5 \\ \hline 125 \end{array}$$

$125¢ = \$1.25$

5. A grown-up person has 2 rows of teeth with 16 teeth in a row. How many teeth is that in all?

6. A garden snail's tongue has 135 rows of teeth, with 105 teeth in each row. How many teeth has a garden snail?

Practice in problem solving

Check each answer. Be sure it is sensible.

1. Find the cost of supplying a spelling book for each of 29 pupils, if the spellers cost $.59 each.

2. Louise spent 35¢ for a roll of film for her camera. She spent 60¢ to have the film developed, and 4¢ apiece to have each of the 8 pictures printed.

How much did the 8 pictures cost all together?

3. Dan's uncle sent him $5.00 for his birthday. How much will Dan have left if he buys 3 tubes for his radio at $1.29 each?

4. Polly had $4.78. She lost 2 coins. Now she has only $4.43. Can you tell what coins she lost?

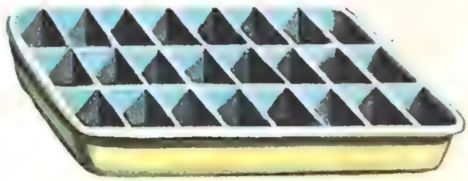
5. George filled 8 egg crates for his father. Each crate holds 12 dozen eggs. How many eggs did George pack all together?

6. Alice Ann has $2.17. How much more does she need to buy 4 victrola records at 79¢ each?

7. Bruce can get a set of eight 89-cent phonograph records for $6.15.

How much can he save by buying the set of 8, instead of buying 8 records, one at a time?

8. The electric refrigerator in Janet's home has 3 of these ice-cube trays. How many ice cubes can Janet make at one time?



9. For working 9 hours at $.45 an hour, Joe will receive _?_.

10. Grace can get a new Girl Scout dress for $5.95. She can buy Ruth's outgrown dress for $3.50. How much can Grace save by buying Ruth's dress?

11. Martha earned $1.90 baby sitting, $.15 for doing an errand, and $1.50 selling greeting cards. How much did she earn in all?

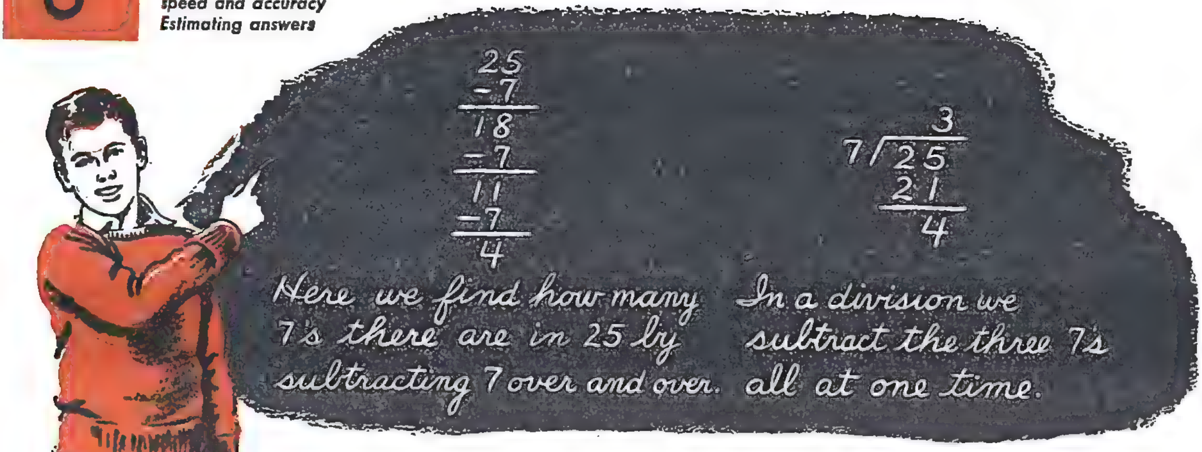
12. The record broad jump for a man is 26 ft. 8 in. A kangaroo can easily jump 30 ft., or _?_ ft. _?_ in. farther than a man.

13. Can you solve these puzzles? Make up some like them for the class to solve.

8?	8?7	?54	78?
× ?	× ?	?	9
425	4842	4270	???6

UNIT 6

Meaning and use of division with one-figure divisors. Practice for speed and accuracy. Estimating answers



Thinking about division

▶ Tom's ideas of division are shown on the blackboard. Show by subtraction and then by division how many 8's there are in 45.

▶ George said, "When I divide 13 by 4, I find how many groups of 4 there are in 13.

"The dots below show that in 13 there are _?_ groups of 4 and _?_ left over." Give other illustrations of George's idea.

● ● ● ●   ● ● ● ●   ● ● ● ●   ●

▶ Bill said, "When you divide, you undo a multiplication. Take 14. Multiply it by 6. You get 84. If you divide 84 by 6, you get back to the 14 you started with when you multiplied.

"Multiplying a number by 6, and then dividing the product by 6, brings you right back to the number you started with."

Give two more illustrations of Bill's idea.

▶ Diana said, "We use division to find how many there are in one of the equal parts of a number.

- "To find $\frac{1}{2}$ of a number, we divide it by 2.
- "To find $\frac{1}{10}$ of a number, we divide it by 10.
- "To find $\frac{1}{5}$ of a number, we divide it by 5."

Illustrate Diana's idea by dealing out 20 cards to 2 persons; to 10 persons; to 5 persons.

▶ Terry said, "Division is something like measuring. To divide 20¢ by 4¢ is like measuring 20¢, using 4¢ as a measuring unit.

"The measuring unit, 4¢, is contained in the 20¢ five times. This shows that 20¢ ÷ 4¢ = 5.

"We use division to find how many times one number is contained in another."

Give other illustrations of Terry's idea.

▶ Harry said, "I can change a multiplication table into a division table." This is what he wrote:

$$6 \times 9 = 54, \text{ so } \begin{cases} 54 \div 9 = 6 \\ 54 \div 6 = 9 \end{cases}$$

$$7 \times 9 = 63, \text{ so } \begin{cases} 63 \div 9 = 7 \\ 63 \div 7 = 9 \end{cases}$$

Give other illustrations of how multiplication facts lead to division facts.

▶ Anita said, "When I want to divide 59 by 9, I think: *What number* × 9 = 59?

"I remember that 6 × 9 = 54. So I see this:" ⟶

$$\begin{array}{r} 6 \\ 9\overline{)59} \\ \underline{54} \\ 5 \end{array}$$

The division shows that 59 ÷ 9 = 6 with a remainder of 5. This is an *uneven* division fact.

Give illustrations of other uneven division facts. Show how to check uneven divisions.

▶ Larry said, "Of course we should *know* all the division facts, but if we forget one, we can always figure it out."

If you forgot these facts, how could you figure them out?

72 ÷ 9   48 ÷ 8   63 ÷ 7

▶ Lois said, "I suppose everybody knows that zero divided by 2, or 3, or any number, is zero."

Prove that Lois is right.

▶ Martin said, "You should use common sense in division.

"To find 936 ÷ 9, I do the division this way:

$$\begin{array}{rl} 900 \div 9 = & 100 \\ \underline{36 \div 9 =} & \underline{\quad 4} \\ \text{so } 936 \div 9 = & 104\text{"} \end{array}$$

Do these divisions by Martin's "common sense" method:

848 ÷ 8   624 ÷ 3   1216 ÷ 4

▶ Dick said, "You use division to find the missing multiplicands or multipliers in examples like these:

$$\begin{cases} 9 \times N = 72 \\ N = 72 \div 9 = 8 \end{cases} \qquad \begin{cases} N \times 8 = 56 \\ N = 56 \div 8 = 7\text{"} \end{cases}$$

Give other illustrations.

▶ Grace said that all these have the same answer. Do they?

48 ÷ 6 $6\overline{)48}$ $\frac{48}{6}$ $\frac{1}{6}$ of 48

Write each of these in three other ways:

42 ÷ 7 = 6   96 ÷ 8 = 12

Thinking about division

1. George Scott flew his plane 748 miles in 5 hours. He thought, "I know the average rate is more than 100 miles an hour." How could he tell that?

2. George was sure that the rate was less than 200 miles an hour. How could he tell that?

3. George found the average rate in two ways shown at the bottom of the page. Explain both ways.

4. How did George check his division? In George's problem, 748 is the _?_, 5 is the _?_, 149 is the _?_, and 3 is the _?_.

5. In the division 9)6350, can you tell at a glance that the quotient must be more than 10? more than 100? less than 1000? Why?

How does knowing $63 \div 9 = 7$ give you a hint that the answer to $6350 \div 9$ is a little more than 700? Do the division and check.

6. In the division 7)6293, must the quotient be more than 100? less than 1000? Why? Is the quotient a 3-digit number?

Would 900 be a sensible estimate of the quotient? Why?

7. To find $\frac{1}{7}$ of \$756, Albert thought:

$$\begin{aligned} \tfrac{1}{7} \text{ of } \$700 &= \$100 \\ \tfrac{1}{7} \text{ of } \$\ \ 56 &= \$\ \ \ 8 \\ \hline \text{so } \tfrac{1}{7} \text{ of } \$756 &= \ \ \underline{\ ?\ } \end{aligned}$$

8. What is the first figure in the quotient in each of these?

7)6293   6)786   9)496

9. How many places will there be in the quotient in each division in Ex. 8? Where will you write the first quotient figure in each division?

10. In which of these divisions is the quotient figure too large?

9	8	9	8
9)85	9)66	7)68	8)69
81	72	63	64

149 5)748 500 248 200 48 45 3 Ans. $149\frac{3}{5}$	quotient → 149 r 3 ← remainder divisor → 5)748 ← dividend 5 24 20 48 45 3 remainder Ans. $149\frac{3}{5}$	Check 149 ×5 745 +3 748

Estimating quotients

1. Answer these questions about this division: $7\overline{)5645}$.

- Is the quotient more than 10?
  10 sevens = ?
- Is the quotient more than 100? 100 sevens = ?
- Is the quotient more than 1000? 1000 sevens = ?
- Is the answer a 2-figure number? a 3-figure number? Why?
- What is the first quotient figure? HINT: $56 \div 7 =$?
- Since the answer is a three-figure number, is 80, or 800, or 8,000 a sensible estimate of the quotient?

2. Is $6325 \div 9$ about 70, about 700, or about 7,000?

3. Is $5\overline{)986}$ about 10, about 100, or about 200?

4. Is $6\overline{)563}$ about 90, about 900, or about 800?

In each division below
- tell how many figures there will be in the quotient.
- tell the first figure of the quotient.
- estimate the quotient.

5.	$5\overline{)4290}$	$5\overline{)4462}$	$5\overline{)460}$
6.	$6\overline{)4782}$	$6\overline{)4807}$	$6\overline{)6900}$
7.	$7\overline{)6350}$	$7\overline{)6256}$	$7\overline{)8400}$
8.	$8\overline{)600}$	$8\overline{)6000}$	$8\overline{)3785}$
9.	$9\overline{)2087}$	$9\overline{)9081}$	$9\overline{)687}$

10. Work the divisions in Exs. 5 to 9. How can you tell whether your answers are sensible?

11. Take the test on page 308 today. Keep practicing until you can write every fact in 5 minutes.

How well can you divide?

DIVISION TEST

Try to do these divisions correctly in 5 minutes:

1. $6\overline{)53}$	2. $8\overline{)946}$	3. $6\overline{)545}$	4. $7\overline{)4928}$	5. $8\overline{)5384}$
6. $9\overline{)585}$	7. $7\overline{)7042}$	8. $5\overline{)4798}$	9. $8\overline{)7593}$	10. $9\overline{)6373}$

If you could not do all of the above examples correctly in 5 minutes, study the division review from here through page 39. Then take the above test again.

Division practice

Do these divisions orally:

	a	b	c	d	e	f	g	h
1.	6)39	4)27	5)38	7)47	9)33	3)20	8)31	7)41
2.	8)29	9)41	7)45	6)27	7)38	4)31	6)23	5)28
3.	4)38	8)36	8)43	9)25	6)45	7)62	5)43	6)53
4.	5)49	7)53	7)33	8)59	9)68	9)58	8)67	9)75
5.	7)59	6)58	7)67	8)78	9)53	8)55	9)80	8)63
6.	6)27	7)44	8)70	9)85	4)39	8)53	9)60	7)52

Copy, divide, and check:

	a	b	c	d	e	f
7.	5)78	4)317	5)518	7)680	8)582	7)$4.83
8.	7)98	6)366	8)694	6)5440	9)6650	9)$8.37
9.	6)94	8)626	6)509	8)7768	7)5427	6)$44.64
10.	7)104	7)598	9)760	9)5640	7)6188	9)$86.18

11. If a plane ticket for an adult costs $105.00, what does a half-fare ticket for a child cost?

12. If 5 boys share equally 85 stamps, each will get _?_ stamps.

13. A 294,000-lb. whale weighs _?_ tons. (Hint: How many 2 thousands are there in 294 thousands?)

14. Joe helps in his father's store. He has an order for 50 quarts of ice cream.

How many gallon cartons of ice cream shall Joe send? Will he need to send any quart packages?

15. Nine boys built a tennis court. They spent $29.25 for materials. If they share the cost equally, what should each pay?

Using division

1. Bill's brother used 2 gallons of gasoline in riding his motorcycle 78 miles. How many miles did he travel on a gallon of gasoline?

2. Eight boys who call themselves the "Atom-splitters" made a radio costing $10.95.

If they share the cost equally, how much should each boy pay?

3. One rainy day $\frac{1}{8}$ of the 840 pupils in Franklin School were absent. How many pupils were absent?

4. There are 6 buses to take 192 pupils to visit the Westtown Airport. The buses are all the same size.

How many pupils should ride in each bus?

5. On Mothers' Visiting Day, the sixth grade is going to serve orange juice.

One can of frozen orange juice makes 6 glasses of juice. How many cans should they buy to make 78 glasses?

6. Joan paid $1.95 for a remnant of blue denim. She made 3 pairs of shorts out of it.

Can you figure out how much each pair of shorts cost?

7. How many 5-cent popcorn balls can you buy for 95¢?

8. In Pine City the schools are open 195 days a year.

If there are 5 school days in a week, how many weeks are the schools open each year?

9. You know how many weeks there are in a year. Can you tell how many weeks of vacation Pine City pupils (Ex. 8) have each year?

10. Your teacher or principal can tell you how many days you go to school each year.

Figure out how many weeks of school you have each year; how many weeks of vacation.

11. How many 8-inch lengths can you cut from 4 yards of string?

12. Five boys were playing with Mr. Grant's rowboat. They broke an oar. The repairs cost $1.75.

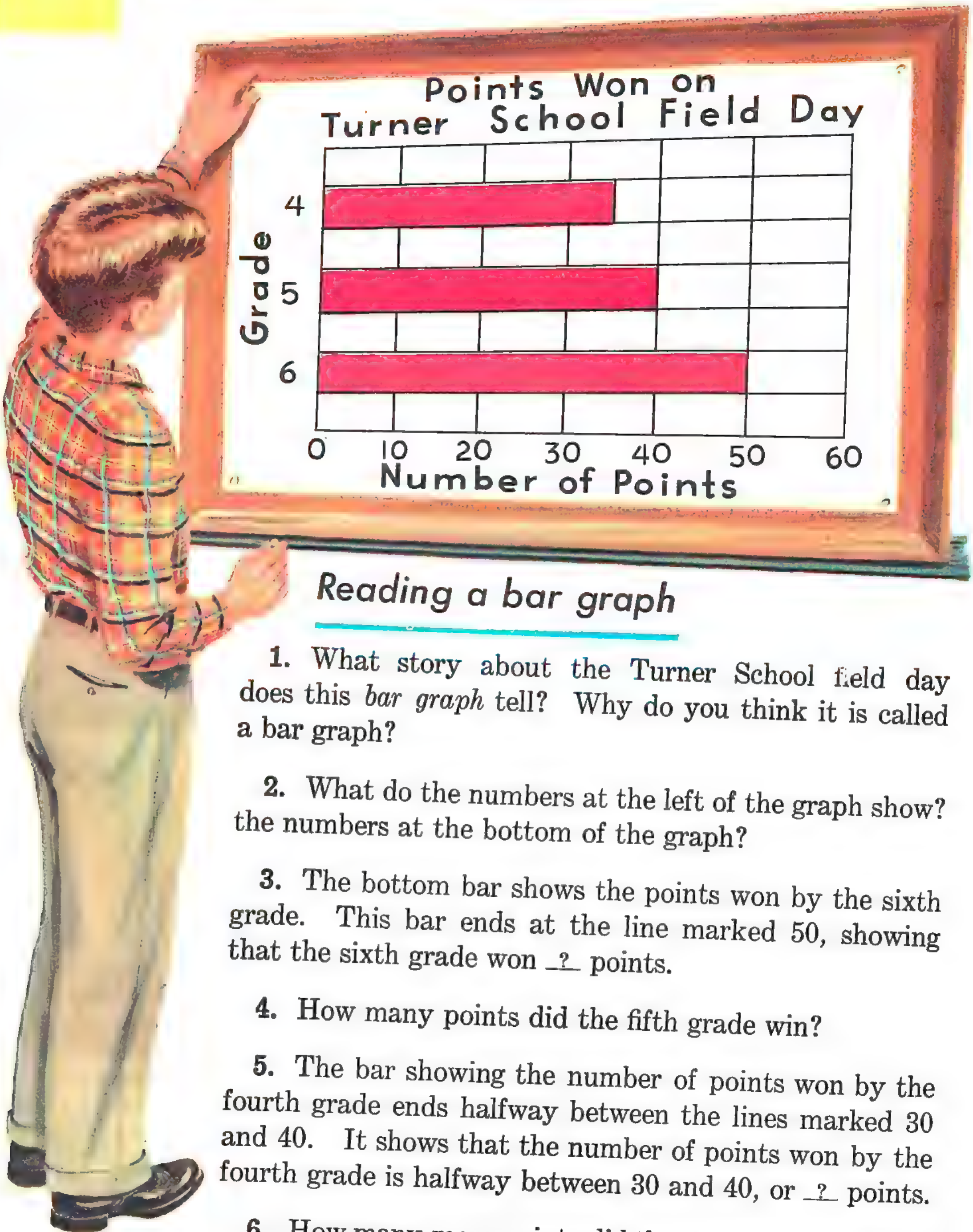
If the boys share the expense equally, how much should each pay?

13. Tom has a wooden pole 10 feet long. He wants to cut it into pieces 8 in. long.

How many cuts will he have to make? (This is a tricky problem.)

UNIT 7

Reading bar graphs
Review practice
Comparing numbers mentally



Reading a bar graph

1. What story about the Turner School field day does this *bar graph* tell? Why do you think it is called a bar graph?

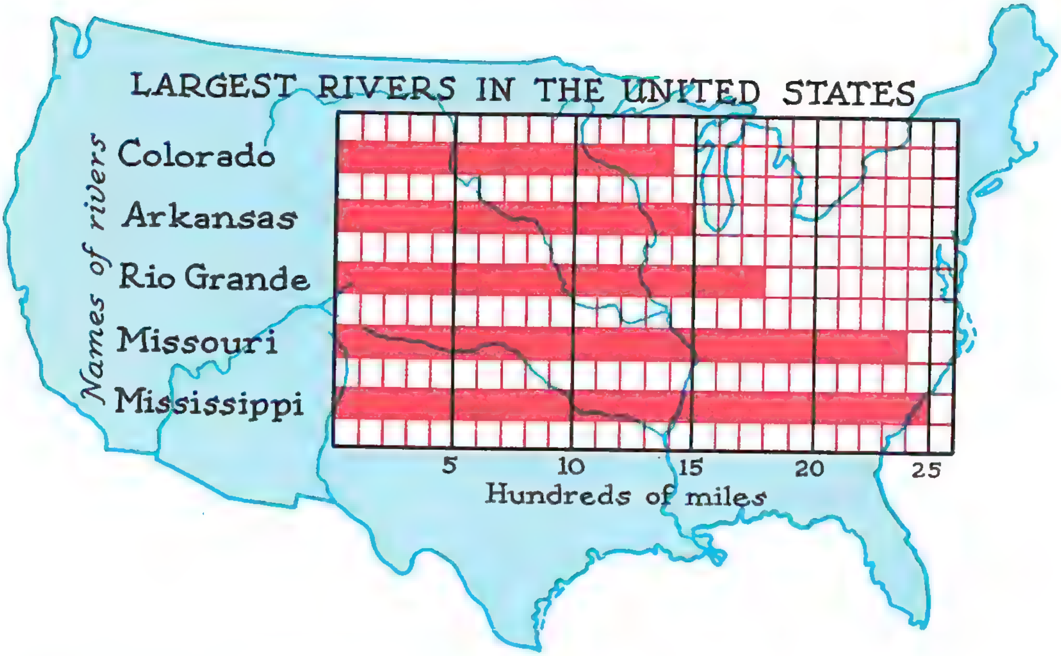
2. What do the numbers at the left of the graph show? the numbers at the bottom of the graph?

3. The bottom bar shows the points won by the sixth grade. This bar ends at the line marked 50, showing that the sixth grade won _?_ points.

4. How many points did the fifth grade win?

5. The bar showing the number of points won by the fourth grade ends halfway between the lines marked 30 and 40. It shows that the number of points won by the fourth grade is halfway between 30 and 40, or _?_ points.

6. How many more points did the sixth grade win than the fifth grade? than the fourth grade?



Round numbers and bar graphs

1. What story does this graph tell about rivers in the United States?

2. Find the rivers on a map.

3. The numbers along the bottom of the graph stand for *hundreds* of miles. The 5 means 500. What do the other numbers mean?

4. How could you show 100 miles on the graph? 200? 300? 400? 700? 1,300?

5. According to the graph, what is the longest river in the United States? How long is it?

How long is each of the other four rivers?

6. Do you think the Mississippi River is *exactly* 2,500 miles long? What are numbers like 2,500 called?

7. Sometimes the length of the Mississippi River is given as 2,470 miles. Why was 2,470 rounded off in the graph to 2,500 instead of to 2,400?

8. In a geography book, the lengths of the other four rivers were given as shown below. Tell how these numbers were rounded off in the graph.

Missouri River	2,432 mi.
Rio Grande	1,801 mi.
Arkansas River	1,450 mi.
Colorado River	1,360 mi.

Review practice

Add and check:

	a	b	c	d	e
1.	\$15.81	\$27.85	\$5.84	\$17.85	\$27.32
	5.46	9.84	3.99	2.49	6.75
	2.87	36.85	.87	6.39	2.48
	.67	4.98	.63	8.74	8.60
	.98	57.63	2.54	9.63	9.76
	.63	2.04	.76	4.70	10.60

Subtract and check:

2.	121	861	954	763	629
	83	435	238	457	546
3.	907	248	1081	3475	600
	284	105	806	868	511
4.	46075	46800	47805	\$168.74	\$265.74
	9987	9876	9387	92.38	146.84

Multiply. Check by going over your work.

5.	84	\$5.63	\$4.07	\$8.67	\$9.84
	27	27	95	75	32
6.	685	875	907	4689	7563
	476	804	654	9	8
7.	854	534	735	805	634
	20	600	906	3000	407

Divide and check:

8.	$6\overline{)374}$	$8\overline{)6416}$	$7\overline{)806}$	$9\overline{)3548}$	$7\overline{)827}$
9.	$4\overline{)3486}$	$5\overline{)375}$	$9\overline{)8632}$	$8\overline{)432}$	$6\overline{)964}$

Comparing numbers mentally

Which is larger, the product of the numbers in Column A or the number in Column B?

	a	b	a	b	a	b
1.	10×12	125	10×27	268	100×23	2,460
2.	10×23	225	10×39	398	1000×37	36,900
3.	10×35	350	100×8	810	1000×85	87,600
4.	10×78	785	100×9	905	1000×92	9,187
5.	10×84	835	100×12	1,189	1000×17	16,803

6. Is $6 \times \$.47$ more than \$3.00?

7. Is $7 \times \$.39$ more than \$2.70?

8. Is $8 \times \$.48$ more than \$4.07?

9. Is $7 \times \$.29$ less than \$2.15?

10. Is $6 \times \$.59$ less than \$3.50?

11. Is $6 \times \$.87$ less than \$5.40?

12. Is $7 \times \$.69$ more than \$4.80?

13. Is $9 \times \$.57$ less than \$5.27?

14. Can $8 \times \$.49$ be subtracted from \$4.00? from \$3.90?

15. Can $9 \times \$.78$ be subtracted from \$7.20? from \$7.00?

16. Can $8 \times \$.94$ be subtracted from \$7.55? from \$7.03?

17. Is 219 more than 10×25?

18. Is 460 less than 10×42?

19. Is 980 less than 10×87?

20. Is 682 more than 10×72?

21. Are there more than ten 65's in 690?

22. Are there more than ten 87's in 833?

23. Are there more than ten 83's in 1000?

24. Is 9824 less than 100×98?

25. Is 7654 less than 100×83?

26. Is 8282 less than 100×82?

27. Is 9810 less than 100×99?

28. Is 746 less than 20×35?

29. Is 4500 less than 200×24?

To the Teacher: See Note 1 on page 310.

UNIT 8

Two-figure divisors. One-, two-, and three-figure quotients. Estimating quotient figures

Working with two-figure divisors

Miss Kelly's sixth-grade pupils have been studying about Mexico. They are setting up an exhibit of Mexican figures they have made.

In order to keep the children in the lower grades from touching the figures, the pupils have decided to rope off a space around the exhibit. By measuring, they have found they will need 108 inches of rope.

Carl said, "The rope is sold by the yard. How many yards of rope do we need?"

Judith said, "There are 36 inches in 1 yard. We have to find out how many 36-inch lengths there are in 108 inches."

Carl, Judith, and George used different ways to find how many 36's there are in 108. Study them. Then decide whose way you prefer.

① Carl started with 108 inches and subtracted 36 over and over as many times as he could. He found that there are _?_ 36's in 108. So he said, "We'll need _?_ yards of rope."

$$\begin{array}{r} 108 \\ -\ 36\checkmark \\ \hline 72 \\ -\ 36\checkmark \\ \hline 36 \\ 36\checkmark \\ \hline 0 \end{array}$$

② Judith made a Helping Table to find how many 36's there are in 108. Why didn't she need to make her table any longer than the one shown here?

$1 \times 36 = 36$
$2 \times 36 = 72$
$3 \times 36 = 108$

Her table shows that it takes _?_ 36's to make 108. She found they will need _?_ yards of rope.

③ George found how many 36's there are in 108 by dividing 108 by 36, like this: →

$$\begin{array}{r} 3 \\ 36\overline{)108} \\ \underline{108} \end{array}$$

▶ He estimated the quotient by thinking, "There are probably as many 36's in 108 as there are 3's in 10.

10 ÷ 3 = 3 r1 gives me a *Hint* that the quotient is 3.

▶ He wrote the quotient, 3, in its place over the 8 in the 108.

▶ He multiplied: 3 × 36 = 108. He wrote the 108 under the 108.

▶ He subtracted 108 from 108. Was there any remainder?

His work shows there are _?_ 36's in 108. It shows that the pupils will need _?_ yards of rope.

▶ Check: Do 3 yards = 108 inches?

Did Carl, Judith, and George get the same answer?

1. Most sixth-grade pupils would find how many 36's there are in 108 by dividing, as George did.

Why is George's way better than Carl's and Judith's?

2. Are there as many as ten 31's in 283? (10 × 31 = _?_)

$31\overline{)283}$

3. To estimate the quotient in Ex. 2, George thought, "There are probably as many 31's in 283 as there are 3's in 28.

"28 ÷ 3 gives me the *Hint* there are _?_ 31's in 283."

4. Copy the division in Ex. 2, divide, and check.

5. Use the *Hint System* to estimate the quotient in this division: $42\overline{)93}$.

Copy, divide, and check.

Estimate the quotients. Then copy, divide, and check.

	a	b	c	d	e
6.	$25\overline{)78}$	$42\overline{)176}$	$51\overline{)383}$	$24\overline{)99}$	$43\overline{)235}$
7.	$60\overline{)190}$	$33\overline{)204}$	$22\overline{)136}$	$43\overline{)188}$	$42\overline{)264}$
8.	$34\overline{)178}$	$43\overline{)221}$	$13\overline{)28}$	$12\overline{)49}$	$13\overline{)29}$
9.	$30\overline{)175}$	$22\overline{)112}$	$22\overline{)53}$	$33\overline{)269}$	$42\overline{)300}$
10.	$44\overline{)98}$	$23\overline{)189}$	$41\overline{)293}$	$22\overline{)139}$	$32\overline{)206}$
11.	$34\overline{)170}$	$24\overline{)96}$	$42\overline{)294}$	$53\overline{)215}$	$23\overline{)139}$

Estimating two-figure quotients

Miss Norton's class is giving a magic show. There are 336 seats in the school auditorium, so Dan and Joyce are to make 336 tickets.

They can make 24 tickets from one sheet of cardboard. They wonder how many sheets of cardboard they should buy.

1. Dan said, "*Some number of sheets of cardboard* $\times$ 24 = 336."

Joyce said, "That's right. I think this way: N $\times$ 24 = 336; so 336 $\div$ 24 = N."

Was Joyce's thinking correct?

2. Before dividing 336 by 24, Dan decided that the quotient was more than 10. How did he know?

3. If they bought 10 sheets of cardboard, how many tickets could they make? Do they need more than 10 sheets?

4. Explain Dan's division below. Does the 1 in tens place mean 10? Where does he get the 240? the 96? the 4? How many sheets did he find were needed?

Dan	Joyce
$\begin{array}{r} 14 \\ 24\overline{)336} \\ 240 \\ \hline 96 \\ 96 \\ \hline \end{array}$	$\begin{array}{r} 14 \\ 24\overline{)336} \\ 24 \\ \hline 96 \\ 96 \\ \hline \end{array}$

5. Explain Joyce's division. How is it like Dan's? In what way does it differ from Dan's? How many sheets did she find were needed?

6. Check their answer. If they can get 24 tickets from one sheet, how many tickets can they make from 14 sheets?

7. Is the quotient of $15\overline{)165}$ more than 10? as much as 20? Estimate it.

8. Is the quotient of $51\overline{)1139}$ more than 10? more than 30? close to 20? Estimate it.

9. Is the quotient of $84\overline{)1986}$ more than 10? close to 20? Why? Estimate it.

10. Is the quotient of $62\overline{)2726}$ more than 10? as much as 100? closer to 30 or 40? more than 40? Estimate it.

11. If a quotient is more than 10 but less than 100, is it a 2-figure number?

12. Tom said he could tell by looking at $93\overline{)3761}$ that the quotient is a 2-figure number, somewhere in the forties. How could he tell that?

Finding two-figure quotients

This is the way most sixth-grade pupils find two-figure quotients:

$$\begin{array}{r} 14 \\ 24\overline{)336} \\ \underline{24} \\ 96 \\ \underline{96} \end{array}$$

336 ÷ 24 = ?. Before you start to divide, estimate the answer. (Is it a 2-figure number? Why? Is it more than 10? more than 20?)

STEPS IN DIVIDING

▶ Estimate the first quotient figure. How many 2's in 3? Write the 1 in tens place. Why?

▶ Multiply: 1 × 24 = 24. Write the 24 under the 33.

▶ Compare: Can 24 be subtracted from 33?

▶ Subtract: 33 − 24 = 9. Bring down the 6.

▶ Divide 96 by 24. Estimate the quotient figure. 9 ÷ 2 = ?. Write the 4 in ones place.

▶ Multiply: 4 × 24 = 96. Write the 96 under the 96.

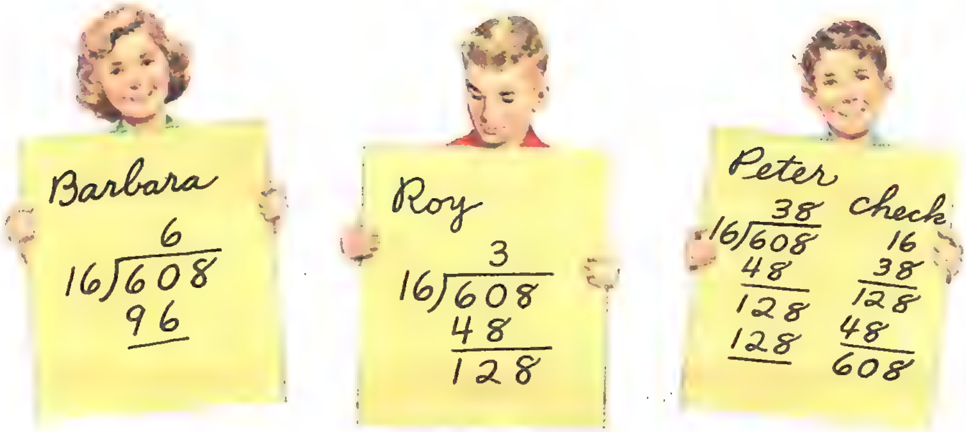
▶ Compare: Can 96 be subtracted from 96?

▶ Subtract: 96 − 96 = 0.

▶ Check: Does 14 × 24 = 336?

Estimate the quotient in each division. Then divide and check.

1.	$41\overline{)943}$	$51\overline{)663}$	$72\overline{)6227}$	$42\overline{)2730}$	$32\overline{)2304}$
2.	$82\overline{)6902}$	$22\overline{)318}$	$81\overline{)5517}$	$73\overline{)2417}$	$51\overline{)3631}$
3.	$72\overline{)4048}$	$62\overline{)2046}$	$94\overline{)1986}$	$93\overline{)2083}$	$62\overline{)2726}$
4.	$91\overline{)2457}$	$61\overline{)5197}$	$71\overline{)5262}$	$52\overline{)1820}$	$72\overline{)3170}$
5.	$93\overline{)5976}$	$83\overline{)2573}$	$62\overline{)2742}$	$53\overline{)1235}$	$92\overline{)3146}$
6.	165 ÷ 15	264 ÷ 22	827 ÷ 31	562 ÷ 42	294 ÷ 14
7.	987 ÷ 21	575 ÷ 52	689 ÷ 53	878 ÷ 51	736 ÷ 23



Finding the right quotient figure

1. Miss Carter asked her class to divide 608 by 16. Has Barbara finished her work? (See picture.)

▶ How did Barbara estimate her first quotient figure? How can she tell it is too large?

▶ Try 5 for the first quotient figure. $5 \times 16 =$ _?_. Can 80 be subtracted from 60?

▶ Try 4 for the first quotient figure; try 3. How can you tell that 3 is correct?

2. Explain Roy's division as far as he has gone. What should he do next?

3. Roy said, "It looks as though $128 \div 16 = 12$." Why did Roy say that?

4. Miss Carter said, "Roy, 12 can't be right; even 10 is too large. $10 \times 16 =$ _?_."

5. Is 9 the quotient figure? How can you tell that 9 is too large?

6. Try 8 for the quotient figure. $8 \times 16 =$ _?_. Is 8 correct? How can you tell?

7. Has Peter finished his division? Is it correct?

8. Peter found there are _?_ 16's in 608. Does his answer check?

Tell how to find the correct quotient figures in these divisions. Then copy, divide, and check.

	a	*b*	*c*
9.	38)190	47)376	18)90
10.	15)75	29)174	36)324
11.	26)108	32)215	37)167
12.	44)336	87)509	19)57
13.	24)100	38)304	29)205
14.	18)61	48)181	18)92
15.	36)264	18)105	47)395
16.	28)185	58)356	74)286
17.	16)59	47)233	62)313

Estimating quotient figures

1. To find the quotient in this division, Thelma said, "There are about as many 48's in 181 as there are 4's in 18."

$\boxed{48\overline{)181}}$

She used 4 for a quotient figure. Was that correct? Is 3 correct?

2. David said, "I know an easier way to find the quotient figure in the division in Ex. 1.

"48 is nearer to 50 than to 40.

"There are probably as many 48's in 181 as there are 50's in 181.

"There are three 50's in 181; so I estimate there are three 48's in 181."

Copy and work the division. Then check to see if David's estimate is correct.

3. To estimate the quotient in this division, David thinks:

$\boxed{29\overline{)162}}$

"29 is very close to 30.

"There are probably as many 29's in 162 as there are 30's in 162."

Tell what David thinks next. Then copy and work the division.

Use David's method to estimate these quotient figures:

4.	$58\overline{)360}$	$39\overline{)310}$	$47\overline{)320}$
5.	$28\overline{)250}$	$69\overline{)360}$	$58\overline{)380}$

6. Copy Exs. 4 and 5 and do the divisions. Then check your work.

7. To estimate how many 21's there are in 159, would you think, "How many 2's in 15?" or "How many 3's in 15?" Why?

8. To estimate how many 47's there are in 262, would you think, "How many 4's in 26?" or "How many 5's in 26?" Why?

9. To estimate how many 38's there are in 152, would you think, "How many 3's in 15?" or "How many 4's in 15?" Why?

10. To estimate how many 23's there are in 75, would you think, "How many 2's in 7?" or "How many 3's in 7?" Why?

Tell the easiest way of estimating the quotient in each of these divisions. Then copy, divide, and check.

	a	*b*	*c*
11.	$21\overline{)159}$	$29\overline{)159}$	$32\overline{)256}$
12.	$37\overline{)256}$	$46\overline{)318}$	$38\overline{)207}$
13.	$48\overline{)200}$	$48\overline{)300}$	$48\overline{)400}$

14. Make up a rule for choosing the easiest way to estimate quotient figures.

To the Teacher: See Note 2, on page 310.

Estimating quotient figures

1. Tell how Ann estimated the quotient in this division.

Wrong
$$\begin{array}{r} 8 \\ 28\overline{)253} \\ \underline{224} \\ 29 \end{array}$$

2. Theodore said, "Ann's quotient figure is too small. The remainder, 29, is larger than the divisor, 28; so there is 1 more 28 in 253. The quotient figure should be 9, not 8."

How does the remainder 29 show that the quotient should be larger?

3. Estimate the quotient in this division. Then see if your estimated quotient is correct.

$$28\overline{)269}$$

All of the quotient figures in Exs. 4–7 are wrong.

Tell how you think the mistake was made in estimating each quotient figure, and whether the figure is too large or too small.

Work each division correctly.

4. WRONG
$$\begin{array}{r} 9 \\ 34\overline{)284} \\ \underline{306} \end{array}$$

5. WRONG
$$\begin{array}{r} 7 \\ 23\overline{)159} \\ \underline{161} \end{array}$$

6. WRONG
$$\begin{array}{r} 6 \\ 47\overline{)340} \\ \underline{282} \\ 58 \end{array}$$

7. WRONG
$$\begin{array}{r} 8 \\ 28\overline{)252} \\ \underline{224} \\ 28 \end{array}$$

First, tell whether the quotient in each division is a 1-figure or a 2-figure number.

Next, tell the easiest way to estimate the first quotient figure.

Then copy, divide, and check.

	a	*b*	*c*	*d*	*e*
8.	$28\overline{)240}$	$29\overline{)224}$	$38\overline{)216}$	$21\overline{)175}$	$24\overline{)99}$
9.	$58\overline{)348}$	$32\overline{)258}$	$69\overline{)350}$	$52\overline{)284}$	$78\overline{)613}$
10.	$71\overline{)684}$	$47\overline{)360}$	$18\overline{)120}$	$79\overline{)474}$	$16\overline{)843}$
11.	$67\overline{)504}$	$43\overline{)246}$	$68\overline{)340}$	$19\overline{)779}$	$46\overline{)3271}$
12.	$26\overline{)1456}$	$31\overline{)293}$	$88\overline{)752}$	$38\overline{)2820}$	$47\overline{)3713}$
13.	$26\overline{)250}$	$26\overline{)240}$	$26\overline{)130}$	$26\overline{)210}$	$26\overline{)200}$

Number, please!

Tell how you find each missing number in Exs. 1–12. Then find the number.

	a	b	c
1.	$N + 12 = 30$	$N \times 7 = 56$	$6 \div N = 6$
2.	$15 + N = 100$	$N \div 5 = 20$	$28 \div N = 7$
3.	$N - 6 = 9$	$50 \div N = 2$	$72 \div N = 8$
4.	$20 - N = 15$	$N + 17 = 100$	$2 \times N = 120$
5.	$7 \times N = 63$	$100 + N = 1000$	$100 - N = 83$
6.	$N - 16 = 14$	$100 - N = 52$	$400 \div N = 50$
7.	$30 - N = 20$	$1000 - N = 30$	$8 \times N = 400$
8.	$8 \times N = 72$	$1000 - N = 1$	$37 - N = 0$
9.	$N \times 6 = 54$	$872 + N = 1000$	$N - 12 = 12$
10.	$N \div 7 = 6$	$N \div 8 = 80$	$N + 12 = 120$
11.	$54 \div N = 9$	$N \times 8 = 5624$	$38 - N = 12$
12.	$250 + N = 400$	$N \div 6 = 125$	$N + 26 = 100$

13. I'm thinking of a number. If I add it to 28, I have 50. What is the number?

14. I'm thinking of a number. If I take it from 64, I have 5 left. What is the number?

15. I'm thinking of a number. If I divide it by 2, I get 1250. What is the number?

16. I'm thinking of a number. If I take 80 from it, I have 53. What is the number?

17. I'm thinking of a number. If I multiply it by 12, the product is 108. What is the number?

18. I'm thinking of a number. If I add $\frac{1}{2}$ to it, I get $1\frac{1}{4}$. What is the number?

To the Teacher: See Note 3 on page 310.

Three-figure quotients

Billy, Patricia, and John needed to divide 5,568 by 24.

1. Estimate the quotient in the division: $24\overline{)5568}$
   - Is it more than 10?
   - Is it more than 100?
   - Is it more than 200?
   - Is it as much as 300?
   - Is it closer to 200 than to 300?

How can you tell?

2. Explain Billy's work in dividing 5,568 by 24.

BILLY

$$\begin{array}{r} 200 \\ 24\overline{)5568} \\ \underline{4800} \\ 768 \end{array} \qquad \begin{array}{r} 30 \\ 24\overline{)768} \\ \underline{720} \\ 48 \end{array} \qquad \begin{array}{r} 2 \\ 24\overline{)48} \\ \underline{48} \end{array}$$

$5568 \div 24 = 200 + 30 + 2 = 232$

What did Billy do with the remainders, 768 and 48?

Is his answer about what you estimated it would be in Ex. 1?

3. Explain Patricia's division.

PATRICIA

$$\begin{array}{r} 232 \\ 24\overline{)5568} \\ \underline{4800} \\ 768 \\ \underline{720} \\ 48 \\ \underline{48} \end{array}$$

JOHN

$$\begin{array}{r} 232 \\ 24\overline{)5568} \\ \underline{48} \\ 76 \\ \underline{72} \\ 48 \\ \underline{48} \end{array}$$

4. Explain John's division.

5. How are Billy's, Patricia's, and John's divisions alike?
   How are they different?

6. Did they all get the same answer? Check it.

7. Estimate the quotient in this division: $31\overline{)9951}$

8. Do the division in Ex. 7, using Billy's method; Patricia's method; John's method.
   Which way do you like best?

9. Estimate the quotient in this division: $43\overline{)9159}$

10. Do the division in Ex. 9, using Billy's method; Patricia's method; John's method.

Estimate these quotients. Then divide and check. Use John's method.

	a	*b*	*c*
11.	$48\overline{)5473}$	$37\overline{)32456}$	$33\overline{)8065}$
12.	$32\overline{)7288}$	$15\overline{)13275}$	$14\overline{)6320}$
13.	$16\overline{)7000}$	$28\overline{)15961}$	$42\overline{)9685}$
14.	$24\overline{)7568}$	$29\overline{)18754}$	$38\overline{)8436}$
15.	$33\overline{)8765}$	$36\overline{)15204}$	$26\overline{)6384}$
16.	$15\overline{)7734}$	$59\overline{)35854}$	$18\overline{)7546}$

Practice in division

Copy the examples below without the work. Then try to work and check them. Compare your work with that in the book.

1.

$$\begin{array}{r} 13\text{ r2} \\ 26\overline{)340} \\ \underline{26} \\ 80 \\ \underline{78} \\ 2 \end{array}
\qquad
\begin{array}{r} \text{CHECK} \\ 26 \\ \underline{\times 13} \\ 78 \\ \underline{26} \\ 338 \\ \underline{+2} \\ 340 \end{array}$$

2.

$$\begin{array}{r} 232\text{ r7} \\ 24\overline{)5575} \\ \underline{48} \\ 77 \\ \underline{72} \\ 55 \\ \underline{48} \\ 7 \end{array}
\qquad
\begin{array}{r} \text{CHECK} \\ 232 \\ \underline{\times 24} \\ 928 \\ \underline{464} \\ 5568 \\ \underline{+7} \\ 5575 \end{array}$$

3.

$$\begin{array}{r} \$\ \ .57\text{ r2¢} \\ 16\overline{)\$9.14} \\ \underline{80} \\ 114 \\ \underline{112} \\ 2 \end{array}
\qquad
\begin{array}{r} \text{CHECK} \\ \$.57 \\ \underline{\times 16} \\ 342 \\ \underline{57} \\ \$9.12 \\ \underline{.02} \\ \$9.14 \end{array}$$

4.

$$\begin{array}{r} \$\ \ 1.97\text{ r37¢} \\ 79\overline{)\$156.00} \\ \underline{79} \\ 770 \\ \underline{711} \\ 590 \\ \underline{553} \\ 37 \end{array}
\qquad
\begin{array}{r} \text{CHECK} \\ \$1.97 \\ \underline{\times 79} \\ 1773 \\ \underline{1379} \\ \$155.63 \\ \underline{+.37} \\ \$156.00 \end{array}$$

Tell whether these divisions have 1-figure, 2-figure, or 3-figure quotients. Estimate the quotients. Then divide and check.

	a	b	c	d	e
5.	$38\overline{)1380}$	$26\overline{)109}$	$43\overline{)1608}$	$23\overline{)368}$	$48\overline{)\$29.78}$
6.	$37\overline{)1762}$	$32\overline{)2172}$	$64\overline{)4596}$	$57\overline{)3848}$	$38\overline{)\$27.25}$
7.	$48\overline{)1810}$	$58\overline{)2765}$	$79\overline{)6728}$	$34\overline{)21320}$	$47\overline{)\$35.83}$
8.	$87\overline{)6546}$	$44\overline{)3344}$	$47\overline{)3958}$	$25\overline{)12926}$	$59\overline{)\$26.82}$
9.	$55\overline{)3575}$	$73\overline{)4975}$	$56\overline{)1536}$	$57\overline{)15200}$	$49\overline{)\$35.92}$
10.	$24\overline{)5568}$	$45\overline{)3465}$	$55\overline{)2655}$	$36\overline{)29953}$	$75\overline{)\$21.40}$

Finding averages

1. Andy made a paddle wheel in science class. Then he put his wheel under a flowing faucet and counted the number of turns it made per minute. The wheel made 67 turns the first minute, 61 the second, and 70 the third.

To find the *average* number of turns per minute, Andy first counted the turns it made in 3 minutes. (67 + 61 + 70 = ?) Then he divided the total by 3.

The wheel made $\frac{1}{3}$ of 198 turns, or an average of ? turns a minute.

2. Did the wheel make exactly 66 turns in any minute? During which minute did it make more than 66 turns? less than 66?

3. Fred's paddle wheel made 260 turns in 4 minutes. Whose wheel made more turns per minute on the average, Andy's or Fred's?

4. Is the average of several different numbers always *less* than the *largest* number? Is it always *larger* than the *smallest* number?

Does it always lie between the largest and the smallest numbers?

5. Joyce made these scores on arithmetic tests: 80, 90, 85, 100. What was her average score?

Which scores pulled her average up? down?

Estimate the averages. Then find them and check your estimates.

6. 12, 16, 21, 11, and 37.

7. 35, 58, 47, and 29.

8. 134, 57, 159, 74, and 200.

9. 78, 146, 93, 82, and 256.

Using averages

1. The average reading rate of sixth-grade pupils is 170 words per minute.

Which of these sixth-grade pupils are below average in reading rate? above average? just average?

	NO. OF WORDS	TIME
David W.	853	5 min.
Fay S.	845	5 min.
Sylvia P.	860	5 min.
John K.	871	5 min.
Thomas W.	795	5 min.
Leroy G.	829	5 min.
Robert P.	910	5 min.

2. Sidney's chickens ate 100 pounds of grain in 5 weeks. They ate an average of _?_ pounds a week.

3. Esther saved $89.00 in a year. She saved _?_ per week on the average.

4. What were Esther's (Ex. 3) average monthly savings?

5. The speed limit on Fairview Road is 50 miles an hour. The law is strictly enforced.

Would you estimate the average rate of travel on Fairview Road to be about 45, 50, or 55 miles per hour? Give a reason for your answer.

6. George says he swam 115 yards in 5 minutes. His average rate of swimming was _?_ yards a minute.

7. Do you think that George (Ex. 6) could swim 60×23 yards in an hour? Explain.

8. Don belongs to a 4-H Club. He raised 285 bushels of corn on a 3-acre field. The yield was an average of _?_ bushels per acre.

9. How could you find out the average number of words you read per minute?

10. What is the average yearly rainfall in your State? Is this average rainfall measured or computed? Explain.

11. Wendy's family took a 380-mile trip in their car. They started at 7 A.M., stopped two hours for lunch and rest, and arrived at 7 P.M.

Their average rate of travel was _?_ miles an hour.

12. What needs have you had for finding averages?

13. Make a bulletin-board exhibit of interesting uses of averages that you find in your reading.

Using arithmetic

1. In 20 hours a train can travel from New York to Chicago, a distance of 1,050 miles. Does the train travel at about 40, 50, or 60 miles an hour?

2. Angeline bought a sweater for $3.98 and 2 pairs of socks at $.69 a pair. How much change did she get from a 10-dollar bill?

3. Billy has saved 650 pennies. How many quarters can he get for them? How many half dollars?

4. John gave his collection of 138 rocks and 48 arrowheads to 6 boys to share equally. How many of each did each boy get?

5. Ed traded his camera, worth $8.25, for Bert's poncho, worth $4.50. How much money should Bert have given Ed?

6. Carl's brother used 12 gallons of gasoline in driving 384 miles. How many miles did he travel on one gallon on the average?

7. The gasoline tank in the Clarks' car holds 14 gallons. Their car travels 18 miles on a gallon of gasoline.

How far can the car travel on a full tank of gasoline?

8. Milton gathers eggs on his father's farm. He has 54 eggs. He wants to pack them in cartons.

Since each carton holds a dozen eggs, how many cartons will he need?

9. During a period of 5 weeks, Dan's pet hen, Cackles, laid 7, 6, 7, 5, and 5 eggs per week. How many eggs did Cackles lay on the average per week?

A practice page

1. $\begin{array}{r} 36 \\ 98 \\ 78 \\ 329 \\ \underline{487} \end{array}$

2. $\begin{array}{r} \$\ .54 \\ 1.76 \\ .89 \\ 3.78 \\ \underline{9.94} \end{array}$

3. $\begin{array}{r} 3007 \\ \underline{-\ 2545} \end{array}$

4. $\begin{array}{r} \$876.84 \\ \underline{-\ 307.59} \end{array}$

5. $\begin{array}{r} 409 \\ \underline{\times\ 75} \end{array}$

6. $\begin{array}{r} 879 \\ \underline{\times\ 608} \end{array}$

7. $75\overline{)5100}$

8. $86\overline{)6425}$

9. $29\overline{)1926}$

10. $33\overline{)3150}$

11. To change 108 inches to yards, divide _?_ by _?_. The answer is _?_ yards.

12. How many 15-cent berry bushes can you buy for $2.00? Will you have any money left?

13. Richard pays 8¢ a bottle for the soft drinks he sells at football games. Look at the picture and find how much he will earn if he sells 179 bottles.

14. The expenses of a class party were $4.56. If the 24 pupils in the class share the cost equally, what should each pupil pay?

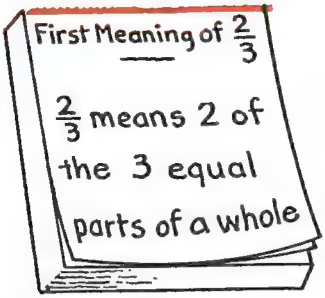
15. Find the cost of a pound of butter at 54¢ a pound, 2 loaves of bread at 17¢ a loaf, and two 27-cent packages of frozen peas.

16. Which of these is the better bargain: 8 bars of Snowy Soap for 60¢, or 12 bars for 83¢?

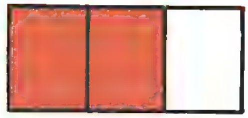
UNIT
10

Thinking about fractions: meanings, vocabulary, and equivalents

Two meanings of a fraction



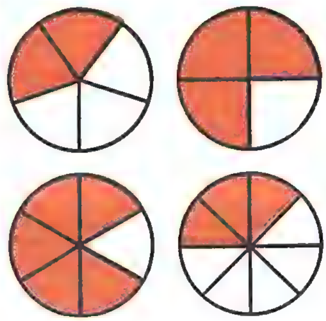
1. Look at the rectangle at the right. $\frac{2}{3}$ of it is colored. What part is white?



2. In the fraction $\frac{2}{3}$, which number, 2 or 3, tells how many parts are colored?

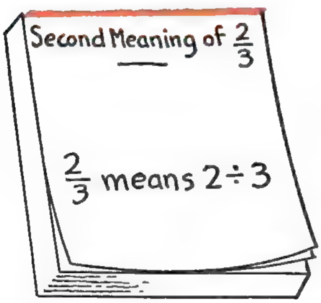
Which number tells how many equal parts there are in the whole rectangle?

3. If a whole is divided into 3 equal parts, the name of each part is a _?_.



4. What is the name of each part of a circle if the circle is divided into 2 equal parts? 4? 5? 6? 8? 10?

5. What part of each of these circles is colored? What part is white?



6. Jack, Pete, and Roy wanted to share 2 sheets of sandpaper equally.

They divided each sheet into 3 equal parts. The J's show that Jack took $\frac{1}{3}$ of the first sheet and $\frac{1}{3}$ of the second sheet. In all he took _?_ thirds of a sheet. $2 \div 3 =$ _?_.

What part of a sheet did Pete get? Roy?

7. Draw 3 pies. Show how 4 boys would share them equally. What part of a pie would each boy get?

$3 \div 4 =$ _?_ $\qquad \frac{1}{4}$ of $3 =$ _?_

8. Draw 2 rectangular cakes. Show how 5 girls would share them equally. What part of a cake would each girl get?

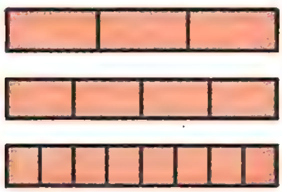
9.	$3 \div 5 =$ _?_	$\frac{1}{5}$ of $3 =$ _?_	$4 \div 5 =$ _?_	$\frac{1}{5}$ of $4 =$ _?_
10.	$5 \div 6 =$ _?_	$\frac{1}{6}$ of $5 =$ _?_	$7 \div 8 =$ _?_	$\frac{1}{8}$ of $7 =$ _?_

Thinking about fractions

1. Which is largest? smallest?

$\frac{1}{2}$ inch $\frac{1}{4}$ inch $\frac{1}{8}$ inch

2. The bars show that $\frac{1}{3}$ is _?_ than $\frac{1}{4}$; that $\frac{1}{4}$ is _?_ than $\frac{1}{8}$.



3. Ex. 2 shows that the more equal parts you divide something into, the _?_ each part will be.

4. Which is largest? smallest?

$\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{5}$ $\frac{1}{10}$

In the fraction $\frac{1}{10}$, 1 is the *numerator*. 10 is the *denominator*.

5. These are *proper fractions:* $\frac{3}{5}$, $\frac{5}{8}$, $\frac{7}{10}$. What do you discover when you compare the numerator with the denominator of each?

In every *proper fraction* the numerator is smaller than the denominator.

6. These are *improper fractions:* $\frac{7}{3}$, $\frac{6}{6}$, $\frac{10}{4}$. What do you discover when you compare the numerator with the denominator of each?

In an *improper fraction* the numerator is equal to or larger than the denominator.

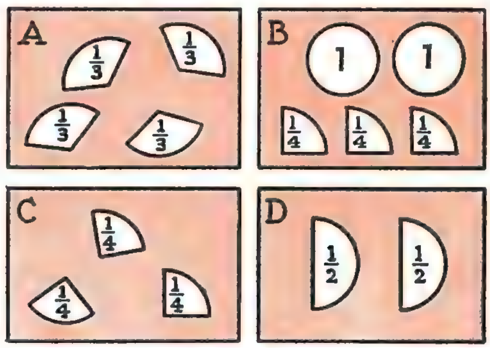
7. These are called *whole numbers*. Can you tell why?

5 23 500 2465

8. These are called *mixed numbers*. Can you tell why?

$1\frac{2}{3}$ $3\frac{5}{6}$ $2\frac{1}{2}$ $4\frac{3}{8}$ $5\frac{4}{5}$

9. In which box do the pieces together show a proper fraction? an improper fraction? a mixed number? a whole number?



10. Name the numerator and the denominator of each:

$\frac{7}{8}$ $\frac{9}{3}$ $\frac{5}{6}$ $\frac{2}{5}$ $\frac{15}{10}$

11. Which of the fractions in Ex. 10 are proper fractions? improper fractions?

12. Which of the following are proper fractions? improper fractions? whole numbers? mixed numbers?

$1\frac{3}{4}$ 12 $\frac{5}{6}$ $\frac{9}{5}$ $\frac{12}{5}$

Thinking about fractions

1. Using a ruler, count by $\frac{1}{2}$ inches from $\frac{1}{2}$ inch to 5 inches. Count backward by half inches from 4 to 1.

2. Use your ruler to prove that both of these ways of counting by $\frac{1}{4}$ inches are correct:

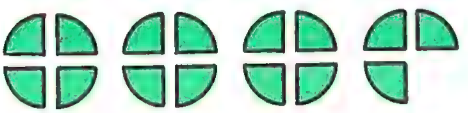
- $\frac{1}{4}$ $\frac{2}{4}$ $\frac{3}{4}$ $\frac{4}{4}$ $\frac{5}{4}$ $\frac{6}{4}$ $\frac{7}{4}$ $\frac{8}{4}$
- $\frac{1}{4}$ $\frac{1}{2}$ $\frac{3}{4}$ 1 $1\frac{1}{4}$ $1\frac{1}{2}$ $1\frac{3}{4}$ 2

3. The counting (Ex. 2) shows:

$\frac{2}{4} = \frac{1}{2}$ $\quad$ $\frac{4}{4} =$ _?_ $\quad$ $\frac{5}{4} =$ _?_

$\frac{6}{4} =$ _?_ $\quad$ $\frac{7}{4} =$ _?_ $\quad$ $\frac{8}{4} =$ _?_

Use this diagram to prove the statements in Exs. 4–21.



4. $\frac{15}{4} = 3\frac{3}{4}$ $\quad$ $\frac{11}{4} = 2\frac{3}{4}$ $\quad$ $\frac{5}{4} = 1\frac{1}{4}$

5. $1\frac{1}{2} = \frac{6}{4}$ $\quad$ $\frac{6}{2} = 3$ $\quad$ $\frac{10}{4} = 2\frac{1}{2}$

6. $\frac{7}{2} = 3\frac{1}{2}$ $\quad$ $\frac{12}{4} = 3$ $\quad$ $\frac{8}{4} = 2$

7. The mixed number $3\frac{3}{4}$ is equal to the improper fraction $\frac{15}{4}$.

8. The improper fraction $\frac{9}{4}$ is equal to the mixed number $2\frac{1}{4}$.

9. $\frac{4}{4} + \frac{4}{4} + \frac{4}{4} + \frac{3}{4} = \frac{15}{4}$.

10. In $3\frac{3}{4}$ there are fifteen $\frac{1}{4}$'s; so $3\frac{3}{4} \div \frac{1}{4} = 15$.

11. In $2\frac{1}{2}$ there are five $\frac{1}{2}$'s; so $2\frac{1}{2} \div \frac{1}{2} = 5$.

12. In 3 there are twelve $\frac{1}{4}$'s; so $3 \div \frac{1}{4} = 12$.

13. $\frac{3}{4} + \frac{3}{4} + \frac{3}{4} + \frac{3}{4} = \frac{12}{4} = 3$.

14. In 3 there are four $\frac{3}{4}$'s; so $3 \div \frac{3}{4} = 4$.

15. 4 times $\frac{3}{4}$ equals 3.

16. The difference between 3 and $1\frac{3}{4}$ is $1\frac{1}{4}$.

17. The sum of $2\frac{1}{2}$ and $\frac{3}{4}$ is $3\frac{1}{4}$.

18. 6 times $\frac{1}{2}$ equals 3.

19. In 2 there are four $\frac{1}{2}$'s; so $2 \div \frac{1}{2} = 4$.

20. 2 times $1\frac{1}{2}$ equals 3.

21. In 3 there are two $1\frac{1}{2}$'s; so $3 \div 1\frac{1}{2} = 2$.

Which statements below cannot be proved by the diagram in the left column? Explain.

22. $3\frac{3}{4} - \frac{5}{4} = 2\frac{1}{2}$ $\quad$ $2\frac{1}{3} - \frac{1}{3} = 2$

23. $2 - \frac{3}{4} = 1\frac{1}{4}$ $\quad$ $2\frac{3}{4} - \frac{1}{2} = 2\frac{1}{4}$

24. $3 - \frac{1}{3} = 2\frac{2}{3}$ $\quad$ $5 - \frac{3}{8} = 4\frac{5}{8}$

25. $2\frac{1}{2} + \frac{1}{4} = 2\frac{3}{4}$ $\quad$ $1\frac{1}{2} + 1\frac{3}{4} = 3\frac{1}{4}$

26. In 3 there are fifteen $\frac{1}{5}$'s; so $3 \div \frac{1}{5} = 15$.

Changing fractions

1. Make a drawing to show that $\frac{7}{3} = 2\frac{1}{3}$. Can you make a rule for changing an improper fraction to a mixed number?

Change these improper fractions to whole or mixed numbers:

2. $\frac{5}{3}$ $\quad\frac{3}{2}$ $\quad\frac{7}{4}$ $\quad\frac{8}{3}$ $\quad\frac{10}{2}$

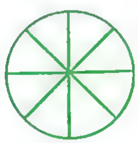
3. $\frac{5}{4}$ $\quad\frac{7}{6}$ $\quad\frac{12}{3}$ $\quad\frac{27}{10}$ $\quad\frac{12}{3}$

4. Make a drawing to show that $2\frac{3}{4} = \frac{11}{4}$. Can you make a rule for changing a mixed number to an improper fraction?

5. Change these mixed numbers to improper fractions. Make drawings to prove you are right.

$2\frac{3}{4}$ $\quad 1\frac{1}{2}$ $\quad 2\frac{1}{3}$ $\quad 5\frac{1}{4}$ $\quad 6\frac{1}{8}$ $\quad 5\frac{3}{10}$

6. This circle shows that:



$\frac{1}{2} = \frac{?}{4}$ $\quad \frac{1}{2} = \frac{?}{8}$ $\quad \frac{1}{4} = \frac{?}{8}$

7. If you multiply both the numerator and the denominator of the fraction $\frac{1}{4}$ by 2, you get this: $\frac{2 \times 1}{2 \times 4}$, or $\frac{2}{8}$. Does $\frac{1}{4} = \frac{2}{8}$?

8. A fraction is changed to an equal fraction by multiplying both its numerator and its denominator by the _?_ number. Give some illustrations.

9. If you divide both the numerator and the denominator of the fraction $\frac{6}{8}$ by 2, you get $\frac{6 \div 2}{8 \div 2}$, or $\frac{3}{4}$.

Use the drawing in Ex. 6 to prove that $\frac{6}{8} = \frac{3}{4}$.

10. A fraction is changed to an equal fraction by dividing both its numerator and its denominator by the _?_ number. Illustrate.

11. How is the fraction $\frac{24}{36}$ changed to $\frac{12}{18}$? to $\frac{8}{12}$? to $\frac{2}{3}$?

12. When $\frac{24}{36}$ is changed to $\frac{2}{3}$, it is said to be reduced to ***lowest terms.*** What does that mean?

To reduce a fraction to lowest terms, divide both the numerator and the denominator by the largest divisor that is common to both.

Reduce to lowest terms:

13. $\frac{12}{24}$ $\quad\frac{8}{24}$ $\quad\frac{12}{16}$ $\quad\frac{16}{20}$

14. $\frac{18}{27}$ $\quad\frac{24}{30}$ $\quad\frac{12}{20}$ $\quad\frac{8}{10}$

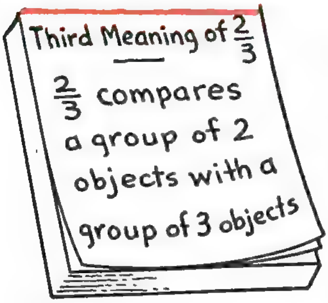
15. Don wrote $\frac{10}{8} = 1\frac{2}{8}$. Ann wrote $\frac{10}{8} = 1\frac{2}{8} = 1\frac{1}{4}$. Whose answer is in better form?

Change to simplest form:

16. $\frac{6}{4}$ $\quad\frac{12}{9}$ $\quad 8\frac{8}{6}$ $\quad 6\frac{4}{6}$

17. $2\frac{8}{8}$ $\quad\frac{4}{10}$ $\quad 4\frac{6}{6}$ $\quad 5\frac{6}{4}$

Comparing numbers



On page 58 you studied two meanings of the fraction $\frac{2}{3}$. Here is a third meaning of $\frac{2}{3}$.

1. 2 out of _?_ kittens at the right are black.

$\frac{2}{3}$ of the kittens are black.

The fraction $\frac{2}{3}$ compares the *number of black kittens* with the *number of kittens in all.*

2. To compare the *number of white kittens* with the *number of kittens in all,* write a fraction. Its numerator is _?_. Its denominator is _?_.

$$\frac{\text{Number of white kittens} \rightarrow 1}{\text{Number of kittens in all} \rightarrow 3}$$

The comparison of the 1 white kitten with the 3 kittens in the group may be read in either of these two ways:

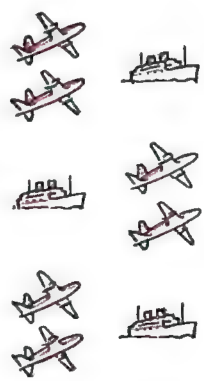
- 1 out of 3 kittens is white.
- $\frac{1}{3}$ of the kittens is white.

3. How would you write a fraction to compare the number of white kittens with the number of black kittens?

$$\frac{\text{Number of white kittens} \rightarrow ?}{\text{Number of black kittens} \rightarrow ?}$$

The comparison of the number of white kittens with the number of black kittens may be read in either of these two ways:

- There are $\frac{1}{2}$ as many white kittens as black kittens.
- There is 1 white kitten for every 2 black kittens.

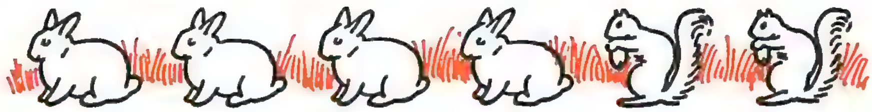


4. How many drawings are there all together at the right? What part of all the drawings are ships?

$$\frac{\text{Compare the number of ships} \longrightarrow 3}{\text{Compare with the number of drawings in all} \rightarrow 9} = \frac{?}{?}$$

5. $\frac{3}{9}$ of the drawings are _?_; but $\frac{3}{9}$ is the same as $\frac{1}{3}$ and that would mean that 1 out of every 3 drawings is a ship. Look at the drawings and see if that is correct.

6. What part of all the drawings are airplanes?



1. Look at these animals. Write a fraction to compare the number of squirrels with the total number of animals.

2. Write a fraction to compare the number of rabbits with the total number of animals.

3. Write a fraction to compare the number of squirrels with the number of rabbits.

$$\frac{\text{Compare}}{\text{Compare with}}\left\{\frac{\text{Number of squirrels}}{\text{Number of rabbits}}\right.\begin{matrix}\to\\ \to\end{matrix}\frac{2}{4}=\frac{?}{?}$$

The comparison may be read in two ways:

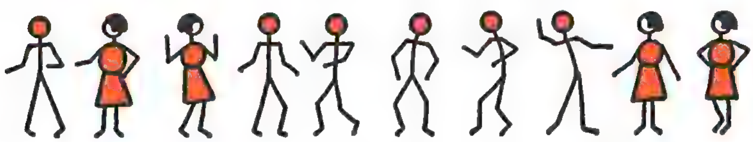
- There are $\frac{1}{2}$ as many squirrels as rabbits.
- There is 1 squirrel for every 2 rabbits.

4. How would the fraction be changed if you compared the number of rabbits with the number of squirrels?

$$\frac{\text{Compare}}{\text{Compare with}}\left\{\frac{\text{Number of rabbits}}{\text{Number of squirrels}}\right.\begin{matrix}\to\\ \to\end{matrix}\frac{4}{2}=\frac{2}{1}$$

The comparison may be read in two ways:

- There are twice as many rabbits as squirrels.
- There are two rabbits for every squirrel.



5. Use this picture of boys and girls to help you make the comparisons below. Read each comparison in two ways.

$$\frac{\text{Compare}}{\text{Compare with}}\left\{\frac{\text{Number of girls}}{\text{Number of children}}\right. \qquad \frac{\text{Compare}}{\text{Compare with}}\left\{\frac{\text{Number of girls}}{\text{Number of boys}}\right.$$

$$\frac{\text{Compare}}{\text{Compare with}}\left\{\frac{\text{Number of boys}}{\text{Number of children}}\right. \qquad \frac{\text{Compare}}{\text{Compare with}}\left\{\frac{\text{Number of boys}}{\text{Number of girls}}\right.$$

$$\frac{\text{Compare}}{\text{Compare with}}\left\{\frac{\text{Number of children}}{\text{Number of girls}}\right. \qquad \frac{\text{Compare}}{\text{Compare with}}\left\{\frac{\text{Number of children}}{\text{Number of boys}}\right.$$

Comparing numbers

1. Study the pictures at the right and the comparison below. Then tell how many circles there should be in the circles' box.

Crosses	Circles
X X X	?

$$\frac{\text{Compare}}{\text{Compare with}}\left\{\frac{\text{Number of crosses} \longrightarrow 3}{\text{Number of circles} \longrightarrow ?}\right. = \frac{1}{3}$$

2. Make as many comparisons as you can about the number of boys and the number of girls in your class.

3. Make as many comparisons as you can about the number of pupils absent and the number of pupils present.

4. Compare the number of school days in a week with the total number of days in a week.

5. Billy is 10 years old and his brother, Bob, is 15. Tell which of these fractions compares Bob's age with Billy's age:

$\frac{10}{15} = \frac{2}{3}$ $\qquad$ $\frac{15}{10} = \frac{3}{2} = 1\frac{1}{2}$

6. Write a fraction to compare the number of inches in a foot with the numbers of inches in a yard.
Reduce the fraction to lowest terms.

7. Write a fraction to compare a penny with a nickel; a nickel with a quarter.

8. Carol had \$12. She spent \$4 for a pair of shoes, \$3 for a skirt, and \$5 for a sweater. Which fraction below shows what part of the money went for a skirt?

$\frac{5}{3}$ $\qquad$ $\frac{4}{5}$ $\qquad$ $\frac{1}{4}$ $\qquad$ $\frac{4}{12}$ $\qquad$ $\frac{12}{3}$

9. Which fraction (Ex. 8) compares the cost of Carol's sweater with the cost of her skirt?

10. The cost of Carol's shoes was what part of the cost of the sweater?

11. What part of Carol's money went for shoes?

12. Make other comparisons about Carol's shopping trip.

13. Write a fraction to compare the number of cents in a dime with the number of cents in a dollar. Reduce the fraction to lowest terms.

14. Compare 8 with 5; compare 5 with 8.

Adding fractions

1. Fractions with denominators that are alike are called ***like fractions.***

$\frac{3}{10}$ and $\frac{5}{10}$ are *like fractions;* the denominator 10 is called a ***common denominator.***

However, $\frac{3}{8}$ and $\frac{3}{10}$ are *unlike fractions;* their denominators (8 and 10) are different.

Only *like fractions* can be added or subtracted.

2. You can add 5 tenths and 3 tenths. The sum is _?_ tenths.

3. Which of these three ways of adding fractions do you prefer?

$$\frac{5}{10} + \frac{3}{10} = \frac{5+3}{10} = \frac{8}{10}$$

5 tenths	$\frac{5}{10}$
+ 3 tenths	$+\frac{3}{10}$
8 tenths	$\frac{8}{10}$

From studying these three additions, make up a rule for adding fractions that are alike.

4. Which of these three ways of subtracting fractions do you prefer?

$$\frac{5}{10} - \frac{3}{10} = \frac{5-3}{10} = \frac{2}{10}$$

5 tenths	$\frac{5}{10}$
− 3 tenths	$-\frac{3}{10}$
2 tenths	$\frac{2}{10}$

Which way suggests a rule for subtracting fractions?

What is your rule?

5. $\frac{7}{8} + \frac{5}{8} = \frac{?}{8} = 1\frac{?}{8} = 1\frac{?}{2}$

6. $\frac{7}{8} - \frac{5}{8} = \frac{?}{8} = \frac{?}{4}$

7. To add $\frac{1}{2}$ and $\frac{1}{3}$, Joyce wrote: ⟶

1 half
+ 1 third

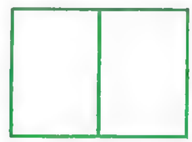
She couldn't go on. Why not?

$\frac{1}{2}$ and $\frac{1}{3}$ are not *like fractions.* They do not have a common denominator.

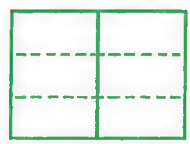
But $\frac{1}{2}$ and $\frac{1}{3}$ can both be changed to have a common denominator. Then they can be added.

8. Joyce found $\frac{1}{2} + \frac{1}{3}$ this way:

▶ She made this rectangle and drew a solid line to divide it into 2 equal parts. Point to $\frac{1}{2}$ the rectangle.



▶ Next she drew dotted lines to divide the rectangle into 3 equal parts. Point to $\frac{1}{3}$ of the rectangle.



The solid and the dotted lines together now divide the rectangle into _?_ equal parts.

▶ She counted the number of sixths in $\frac{1}{2}$ of the rectangle, and then in $\frac{1}{3}$ of the rectangle.

▶ She counted the number of sixths in $\frac{1}{2}$ of the rectangle and $\frac{1}{3}$ of the rectangle together.

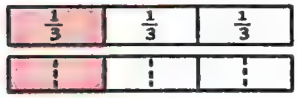
$\frac{1}{2} = \frac{?}{6}$ $\quad \frac{1}{3} = \frac{?}{6}$ $\quad \frac{3}{6} + \frac{2}{6} = \frac{?}{6}$

Adding and subtracting fractions

1. What does this diagram show you about halves? ⟶

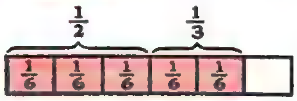
$\frac{1}{2} = \frac{?}{6}$

2. What does this diagram show you about thirds? ⟶



$\frac{1}{3} = \frac{?}{6}$

3. What does this diagram show you about $\frac{1}{2} + \frac{1}{3}$? ⟶



$\frac{3}{6} + \frac{2}{6} = \frac{?}{6}$

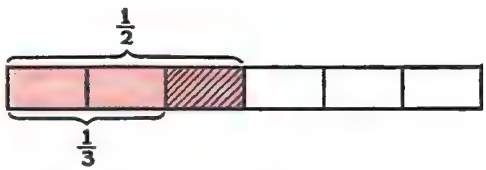
4. *Unlike fractions,* such as $\frac{1}{2}$ and $\frac{1}{3}$, must be changed to have a common denominator before they can be added or subtracted. Explain the addition at the right.

$$\begin{array}{r} \frac{1}{2} = \frac{3}{6} \\ \frac{1}{3} = \frac{2}{6} \\ \hline \frac{5}{6} \end{array}$$

5. Can you subtract $\frac{1}{3}$ from $\frac{1}{2}$ this way? ⟶

$$\begin{array}{r} \text{1 half} \\ -\ \text{1 third} \\ \hline \end{array}$$

6. The diagram at the right shows that $\frac{1}{2} = \frac{?}{6}$; $\frac{1}{3} = \frac{?}{6}$. Now use the diagram to show that $\frac{1}{2} - \frac{1}{3} = \frac{1}{6}$.



7. Before you can subtract $\frac{1}{3}$ from $\frac{1}{2}$ you must find a common denominator for the two fractions. Can you use 6 for the common denominator?

$$\begin{array}{r} \frac{1}{2} = \frac{3}{6} \\ -\frac{1}{3} = \frac{2}{6} \\ \hline \frac{?}{6} \end{array}$$

8. Draw diagrams to help explain these addition and subtraction examples:

a	*b*	*c*	*d*	*e*	*f*
$\begin{array}{r} \frac{1}{5} \\ +\frac{2}{5} \\ \hline \frac{3}{5} \end{array}$	$\begin{array}{r} \frac{3}{8} = \frac{3}{8} \\ +\frac{1}{4} = \frac{2}{8} \\ \hline \frac{5}{8} \end{array}$	$\begin{array}{r} \frac{1}{4} = \frac{3}{12} \\ +\frac{2}{3} = \frac{8}{12} \\ \hline \frac{11}{12} \end{array}$	$\begin{array}{r} \frac{4}{5} \\ -\frac{3}{5} \\ \hline \frac{1}{5} \end{array}$	$\begin{array}{r} \frac{3}{4} = \frac{6}{8} \\ -\frac{1}{8} = \frac{1}{8} \\ \hline \frac{5}{8} \end{array}$	$\begin{array}{r} \frac{3}{4} = \frac{9}{12} \\ -\frac{1}{3} = \frac{4}{12} \\ \hline \frac{5}{12} \end{array}$

9. How would you find the missing numerator in $\frac{4}{5} = \frac{?}{10}$? Explain this way of doing it: $\frac{4}{5} = \frac{2 \times 4}{2 \times 5} = \frac{8}{10}$

10. Find the missing numerators:

$\frac{2}{5} = \frac{?}{10}$ $\quad \frac{2}{3} = \frac{?}{6}$ $\quad \frac{3}{4} = \frac{?}{12}$ $\quad \frac{1}{2} = \frac{?}{10}$ $\quad \frac{2}{3} = \frac{?}{12}$ $\quad \frac{3}{4} = \frac{?}{8}$ $\quad \frac{3}{5} = \frac{?}{10}$ $\quad \frac{1}{6} = \frac{?}{12}$

Finding common denominators

1. When Bill added $\frac{1}{2}$ and $\frac{1}{4}$, he thought, "$\frac{4}{8} + \frac{2}{8} = \frac{6}{8}$, or $\frac{3}{4}$."

When Agnes did the addition, she thought, "$\frac{2}{4} + \frac{1}{4} = \frac{3}{4}$."

What common denominator did Bill use? Agnes? The ***smallest common denominator*** is _?_.

2. Find the smallest common denominator of:

$\frac{1}{2}$, $\frac{3}{4}$, and $\frac{5}{8}$ $\frac{2}{3}$, $\frac{1}{2}$, and $\frac{5}{12}$

Here is a good way to find the smallest common denominator of two fractions:

▶ Look to discover whether the larger denominator is the common denominator.

▶ If it is not, try 2 times the larger denominator.

▶ If two times won't do, try 3 times the larger denominator; and so on.

3. First tell what common denominator to use in each example below. Then work the example.

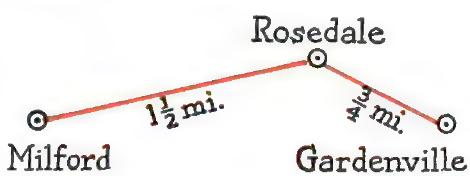
$\frac{1}{2} + \frac{1}{3}$ $\frac{1}{3} + \frac{1}{12}$ $\frac{1}{4} + \frac{1}{6}$ $\frac{1}{3} + \frac{1}{4}$

4. Which of the numbers 3, 6, 9, 12, and 15 are common denominators of the fractions $\frac{1}{2}$ and $\frac{1}{3}$? Which is the smallest common denominator?

5. Find the smallest common denominator of each of these groups of fractions:

$\frac{5}{6}, \frac{1}{4}$ $\frac{1}{2}, \frac{2}{3}, \frac{1}{4}$ $\frac{3}{4}, \frac{1}{2}, \frac{5}{6}$ $\frac{3}{5}, \frac{3}{4}$

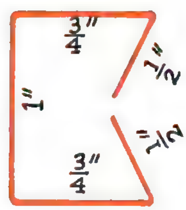
6. How far is it by road from Milford to Gardenville?



7. Sara is making a costume. The pattern calls for $\frac{2}{3}$ yd. of fringe for the apron and $\frac{3}{4}$ yd. for the cape. How much fringe does Sara need all together?

8. The clerk will not sell Sara $1\frac{5}{12}$ yd. of fringe, but will sell her $1\frac{1}{4}$ yd., $1\frac{1}{2}$ yd., or $1\frac{3}{4}$ yd. Which of these should Sara take? Explain why.

9. How long a piece of wire would you need to make this: ⟶



10. A Scout troop is hiking from Newtown to Cliffside Park and back. The distance between the two places is $2\frac{7}{10}$ mi.

How long a hike will the troop have?

Practice in adding fractions

Below are 6 examples in adding fractions and mixed numbers. Explain exactly how each example is done.

1.
$$\begin{array}{r} \frac{3}{5} \\ +\ \frac{4}{5} \\ \hline \frac{7}{5} = 1\frac{2}{5} \end{array}$$

2.
$$\begin{array}{r} \frac{5}{12} \\ +\ \frac{5}{12} \\ \hline \frac{10}{12} = \frac{5}{6} \end{array}$$

3.
$$\begin{array}{r} \frac{3}{8} \\ +\ \frac{7}{8} \\ \hline \frac{10}{8} = 1\frac{2}{8} = 1\frac{1}{4} \end{array}$$

4.
$$\begin{array}{rcl} \frac{7}{10} & = & \frac{7}{10} \\ +\ \frac{3}{5} & = & \frac{6}{10} \\ \hline & & \frac{13}{10} = 1\frac{3}{10} \end{array}$$

5.
$$\begin{array}{rcl} 1\frac{3}{4} & = & 1\frac{9}{12} \\ +\ 2\frac{5}{6} & = & 2\frac{10}{12} \\ \hline & & 3\frac{19}{12} = 3 + 1\frac{7}{12} = 4\frac{7}{12} \end{array}$$

6.
$$\begin{array}{rcl} \frac{2}{5} & = & \frac{4}{10} \\ 1\frac{1}{2} & = & 1\frac{5}{10} \\ +\ \frac{3}{5} & = & \frac{6}{10} \\ \hline & & 1\frac{15}{10} = 1 + 1\frac{5}{10} = 2\frac{5}{10} = 2\frac{1}{2} \end{array}$$

Find these sums:

	a	b	c	d	e	f	g	h
7.	$\frac{3}{8}$ $\frac{2}{8}$	$\frac{7}{10}$ $\frac{2}{10}$	$\frac{1}{6}$ $\frac{7}{12}$	$1\frac{3}{4}$ $\frac{1}{8}$	$2\frac{1}{6}$ $5\frac{1}{3}$	$\frac{1}{4}$ $\frac{1}{3}$	$\frac{5}{6}$ $1\frac{1}{6}$	$\frac{7}{10}$ $\frac{2}{5}$
8.	$\frac{9}{10}$ $\frac{2}{5}$	$\frac{7}{8}$ $\frac{1}{2}$	$\frac{7}{10}$ $\frac{7}{10}$	$\frac{1}{4}$ $\frac{2}{3}$	$\frac{1}{12}$ $\frac{3}{4}$	$2\frac{5}{6}$ $3\frac{1}{2}$	$\frac{3}{4}$ $4\frac{7}{16}$	$2\frac{7}{8}$ $5\frac{3}{4}$
9.	$\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{8}$	$5\frac{3}{5}$ $2\frac{1}{10}$ 3	$2\frac{5}{12}$ $6\frac{3}{4}$ 4	$\frac{7}{8}$ $9\frac{1}{2}$ $5\frac{1}{4}$	$\frac{7}{12}$ $\frac{3}{4}$ $\frac{2}{3}$	$1\frac{1}{2}$ $\frac{3}{4}$ $2\frac{5}{6}$	$4\frac{3}{8}$ $3\frac{1}{2}$ $5\frac{5}{16}$	$2\frac{5}{12}$ $6\frac{5}{6}$ 8
10.	$\frac{1}{3}$ $\frac{1}{2}$ $\frac{1}{6}$	4 $3\frac{5}{8}$ $2\frac{3}{4}$	$\frac{7}{8}$ 5 $4\frac{1}{2}$	$\frac{9}{10}$ $2\frac{3}{10}$ 4	$\frac{5}{6}$ $\frac{5}{12}$ $\frac{1}{3}$	$2\frac{7}{10}$ $3\frac{1}{10}$ $4\frac{1}{5}$	$3\frac{1}{2}$ $2\frac{3}{4}$ $\frac{1}{3}$	$\frac{7}{10}$ $\frac{1}{2}$ $5\frac{1}{5}$

A test in adding fractions

One sixth-grade class made an average score of 19 on this test. Can your class do as well? Copy the examples. An answer is counted wrong if it is not in simplest form.

Arithmetic Sixth Grade Date————

Name——————

1. $\frac{1}{12} + \frac{1}{12} =$

2. $\frac{1}{10} + \frac{7}{10} + \frac{9}{10} =$

3. $\frac{2}{3} + \frac{7}{12} =$

4. $\frac{3}{8} + \frac{1}{4} + \frac{5}{16} =$

5. $\begin{array}{r} \frac{5}{6} \\ + \frac{5}{12} \\ \hline \end{array}$

6. $\begin{array}{r} 2\frac{2}{3} \\ + \frac{5}{6} \\ \hline \end{array}$

7. $\begin{array}{r} 10\frac{3}{4} \\ \frac{7}{8} \\ + 1\frac{1}{2} \\ \hline \end{array}$

8. $\frac{4}{5} + \frac{1}{2} =$

9. $1\frac{1}{2} + 1\frac{1}{3} =$

10. $\frac{1}{6} + \frac{2}{3} + \frac{1}{4} =$

11. $\frac{1}{2} + \frac{2}{5} + \frac{1}{4} =$

12. $5\frac{3}{4} + \frac{1}{6} =$

13. $10\frac{9}{10} + 5\frac{3}{5} =$

14. $2\frac{5}{8} + 1\frac{3}{4} =$

15. $\begin{array}{r} \frac{7}{12} \\ 5\frac{1}{4} \\ + 8\frac{1}{6} \\ \hline \end{array}$

16. $\begin{array}{r} 8\frac{7}{16} \\ + 2\frac{9}{16} \\ \hline \end{array}$

17. $\begin{array}{r} 5\frac{1}{2} \\ 9\frac{4}{5} \\ + 6\frac{7}{10} \\ \hline \end{array}$

18. $\begin{array}{r} 5\frac{1}{2} \\ + 2\frac{2}{5} \\ \hline \end{array}$

19. $\begin{array}{r} 20\frac{2}{9} \\ + 12\frac{2}{3} \\ \hline \end{array}$

20. $\begin{array}{r} 6\frac{1}{4} \\ 6\frac{2}{5} \\ + \frac{7}{10} \\ \hline \end{array}$

Practice in subtracting fractions

1. $\frac{3}{10}$ can be subtracted from $\frac{7}{10}$ without changing either fraction because the fractions have a _?_ denominator.

2. $\frac{5}{6}-\frac{1}{6}=?$ $\quad\frac{7}{10}-\frac{3}{10}=?$ $\quad\frac{11}{12}-\frac{5}{12}=?$

3. To subtract $\frac{1}{6}$ from $\frac{3}{4}$, you must find a common denominator of $\frac{1}{6}$ and $\frac{3}{4}$. The smallest common denominator is _?_.

4. A common denominator of $\frac{3}{5}$ and $\frac{7}{10}$ is 20, but the *smallest* common denominator is _?_.

5. Tell the smallest common denominator of each of these pairs of fractions:

$\frac{5}{6}, \frac{1}{3}$ $\quad\frac{7}{8}, \frac{1}{4}$ $\quad\frac{1}{2}, \frac{1}{5}$ $\quad\frac{1}{3}, \frac{1}{4}$ $\quad\frac{3}{4}, \frac{1}{6}$

Supply the missing numerators:

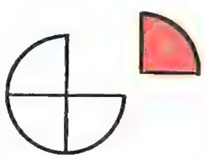
6. $\frac{1}{5}=\frac{?}{10}$ $\quad\frac{1}{2}=\frac{?}{10}$ $\quad\frac{2}{3}=\frac{?}{6}$

7. $\frac{2}{3}=\frac{?}{12}$ $\quad\frac{3}{4}=\frac{?}{12}$ $\quad\frac{5}{8}=\frac{?}{16}$

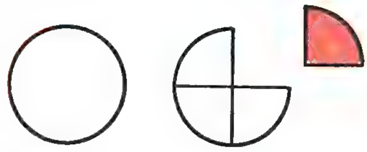
8. Copy and subtract:

$$\begin{array}{r}4\frac{1}{2}\\-\frac{1}{3}\\\hline\end{array}\qquad\begin{array}{r}1\frac{4}{5}\\-\frac{1}{10}\\\hline\end{array}\qquad\begin{array}{r}2\frac{5}{6}\\-\frac{1}{4}\\\hline\end{array}\qquad\begin{array}{r}4\frac{2}{3}\\-\frac{1}{4}\\\hline\end{array}$$

9. If you cut $\frac{1}{4}$ of a circle from a whole circle, what part is left?



10. To subtract $\frac{1}{4}$ from 1, think of 1 as $\frac{4}{4}$. $\frac{4}{4}-\frac{1}{4}=\frac{?}{4}$.



11. To subtract $\frac{1}{4}$ from 2, think of 2 as $1\frac{4}{4}$. $1\frac{4}{4}-\frac{1}{4}=$ _?_.

Make a drawing to prove your answer in each of these:

12. $3-\frac{1}{4}=?$ $\quad 4-\frac{1}{3}=?$ $\quad 2-\frac{1}{5}=?$

13. $4-\frac{2}{3}=?$ $\quad 5-\frac{3}{4}=?$ $\quad 6-\frac{5}{6}=?$

14. In this subtraction can you take $\frac{3}{8}$ from $\frac{1}{8}$? Then what should you do? Does $6\frac{1}{8}=5\frac{9}{8}$? $5\frac{9}{8}-2\frac{3}{8}=$ _?_.

$$\boxed{\begin{array}{r}6\frac{1}{8}\\-\,2\frac{3}{8}\\\hline\end{array}}$$

15. Tell the missing numbers:

$$\begin{array}{rl}6\frac{1}{4}=&5\frac{5}{4}\\-\,2\frac{3}{4}=&2\frac{3}{4}\\\hline 3\frac{?}{4}=&3\frac{?}{2}\end{array}\qquad\begin{array}{rl}5\frac{1}{6}=&4\frac{7}{6}\\-\,2\frac{5}{6}=&2\frac{5}{6}\\\hline 2\frac{?}{6}=&2\frac{?}{3}\end{array}$$

16. Copy and subtract:

$$\begin{array}{r}4\frac{1}{6}\\-\,1\frac{5}{6}\\\hline\end{array}\qquad\begin{array}{r}3\frac{3}{8}\\-\,1\frac{7}{8}\\\hline\end{array}\qquad\begin{array}{r}5\frac{1}{5}\\-\,2\frac{4}{5}\\\hline\end{array}\qquad\begin{array}{r}4\frac{2}{5}\\-\,1\frac{4}{5}\\\hline\end{array}$$

17. Tell the missing numbers:

$$\begin{array}{rcl}3\frac{1}{2}=&3\frac{5}{10}=&2\frac{15}{10}\\-\frac{4}{5}=&\frac{?}{10}=&\frac{8}{10}\\\hline&&2\frac{?}{10}\end{array}$$

18. Copy and subtract:

$$\begin{array}{r}2\frac{1}{4}\\-\frac{2}{3}\\\hline\end{array}\qquad\begin{array}{r}4\frac{3}{8}\\-\frac{3}{4}\\\hline\end{array}\qquad\begin{array}{r}5\frac{1}{2}\\-\frac{7}{8}\\\hline\end{array}\qquad\begin{array}{r}5\frac{1}{2}\\-\frac{3}{10}\\\hline\end{array}$$

Everyday problems

1. Mary Ellen has 2 pies. If she serves $\frac{1}{6}$ of a pie to each of 5 persons, how much pie will she have left?

Do a subtraction to find your answer. Draw a picture to prove your answer is right.

2. From Ferndale to Rockville is $5\frac{1}{2}$ miles. Roy rode on a truck for $3\frac{7}{10}$ miles of this distance and walked the rest of the way. How far did he walk?

3. Edith has $20.00 in her school savings account. If she takes out enough money to buy roller skates for $1.89 and a soft-ball for 59¢, how much will she have left in her account?

4. There are 864 pupils enrolled in the Knox School. There are 24 classrooms. Find the average number of pupils per classroom.

5. 19 boys in a club paid $23.37 for materials to make a radio. If they share the cost equally, how much should each pay?

6. Nancy wants to make a doll's dress. The pattern calls for $\frac{3}{4}$ yd. of material. She can get a remnant marked $\frac{5}{8}$ yd. Will that be enough?

7. A State law allows Tim to catch 12 fish a day. Look at the picture. What part of the day's catch does he have so far?

Oral subtraction practice

Here are nine important kinds of examples in subtracting fractions. Explain exactly how each example is worked.

1. $$\begin{array}{r} \frac{7}{8} \\ -\frac{3}{8} \\ \hline \frac{4}{8} = \frac{1}{2} \end{array}$$

2. $$\begin{array}{rcl} \frac{7}{10} & = & \frac{7}{10} \\ -\frac{2}{5} & = & \frac{4}{10} \\ \hline & & \frac{3}{10} \end{array}$$

3. $$\begin{array}{rcl} 5\frac{1}{4} & = & 5\frac{3}{12} \\ -4\frac{1}{6} & = & 4\frac{2}{12} \\ \hline & & 1\frac{1}{12} \end{array}$$

4. $$\begin{array}{rcl} 1 & = & \frac{4}{4} \\ -\frac{1}{4} & = & \frac{1}{4} \\ \hline & & \frac{3}{4} \end{array}$$

5. $$\begin{array}{rcl} 5 & = & 4\frac{3}{3} \\ -\frac{2}{3} & = & \frac{2}{3} \\ \hline & & 4\frac{1}{3} \end{array}$$

6. $$\begin{array}{rcl} 4 & = & 3\frac{3}{3} \\ -1\frac{2}{3} & = & 1\frac{2}{3} \\ \hline & & 2\frac{1}{3} \end{array}$$

7. $$\begin{array}{rcl} 4\frac{1}{6} & = & 3\frac{7}{6} \\ -3\frac{5}{6} & = & 3\frac{5}{6} \\ \hline & & \frac{2}{6} = \frac{1}{3} \end{array}$$

8. $$\begin{array}{rcl} 5\frac{1}{8} & = & 4\frac{9}{8} \\ -1\frac{7}{8} & = & 1\frac{7}{8} \\ \hline & & 3\frac{2}{8} = 3\frac{1}{4} \end{array}$$

9. $$\begin{array}{rcccl} 4\frac{1}{4} & = & 4\frac{3}{12} & = & 3\frac{15}{12} \\ -2\frac{1}{3} & = & 2\frac{4}{12} & = & 2\frac{4}{12} \\ \hline & & & & 1\frac{11}{12} \end{array}$$

Written subtraction practice

Copy and subtract:

	a	b	c	d	e	f
1.	$2\frac{1}{2} - \frac{3}{5}$	$3\frac{1}{3} - \frac{5}{6}$	$4\frac{1}{4} - 1\frac{7}{12}$	$5\frac{1}{3} - 1\frac{3}{4}$	$4\frac{1}{2} - \frac{7}{8}$	$5\frac{1}{6} - 2\frac{2}{3}$
2.	$\frac{7}{8} - \frac{5}{8}$	$\frac{9}{10} - \frac{3}{5}$	$4\frac{1}{2} - 1\frac{1}{3}$	$5\frac{7}{8} - 2\frac{3}{8}$	$5\frac{1}{10} - 2\frac{1}{2}$	$6\frac{3}{8} - 5$
3.	$\frac{9}{10} - \frac{3}{10}$	$\frac{7}{12} - \frac{1}{3}$	$5\frac{3}{4} - 4\frac{1}{3}$	$6\frac{5}{6} - 4\frac{1}{3}$	$8\frac{7}{8} - \frac{1}{4}$	$9\frac{3}{10} - 4\frac{4}{5}$

4. Alice has 10 yd. of ribbon. If she uses $1\frac{3}{4}$ yd. to tie a gift package, how much will be left?

5. Joan has $2\frac{1}{2}$ lb. of butter. If she uses $\frac{3}{4}$ lb. for a cake, how much will she have left?

6. Peter had a pint (2 cups) of molasses. He used $\frac{3}{4}$ cup in making popcorn balls. Has he $1\frac{1}{2}$ cups left to make some taffy?

7. Tell an easy way to decide which is larger: $\frac{7}{8}$ or $\frac{13}{16}$; $\frac{9}{10}$ or $\frac{4}{5}$.

More practice in subtracting fractions

Easy practice

1. $\frac{7}{8}$ is how much more than $\frac{5}{8}$?

2. $\frac{1}{4}$ is how much less than $\frac{7}{8}$?

3. Take $\frac{1}{2}$ from $\frac{5}{6}$; from $\frac{7}{8}$; from $\frac{11}{12}$; from $\frac{9}{10}$.

4. $\frac{7}{10} - \frac{3}{10}$ 5. $\frac{1}{3} - \frac{1}{6}$ 6. $\frac{3}{4} - \frac{1}{2}$ 7. $\frac{1}{3} - \frac{1}{4}$

8. $\frac{3}{4} - \frac{3}{8}$ 9. $2\frac{5}{12} - \frac{1}{3}$ 10. $\frac{9}{16} - \frac{3}{8}$ 11. $6\frac{11}{12} - 2\frac{3}{4}$ 12. $5\frac{3}{4} - 1\frac{1}{3}$

Harder practice

1. How much less than $4\frac{7}{8}$ is $4\frac{1}{4}$?

2. How much more than 3 is $4\frac{1}{2}$?

3. How much is left when you take $\frac{1}{6}$ from $\frac{7}{12}$?

4. $\frac{7}{8} - \frac{3}{4}$ 5. $\frac{2}{3} - \frac{3}{6}$ 6. $\frac{3}{4} - \frac{2}{3}$ 7. $\frac{11}{12} - \frac{5}{6}$

8. $\frac{5}{8} - \frac{3}{16}$ 9. $2\frac{7}{10} - \frac{2}{5}$ 10. $5\frac{11}{12} - \frac{5}{6}$ 11. $8\frac{7}{8} - 2\frac{9}{16}$ 12. $20\frac{3}{4} - 8\frac{1}{12}$

Still harder practice

1. Find the difference between $\frac{3}{4}$ and $\frac{2}{3}$.

2. Find the difference between 6 and $3\frac{3}{4}$.

3. Find the difference between $2\frac{1}{2}$ and $5\frac{1}{3}$.

4. $1 - \frac{2}{3}$ 5. $5 - \frac{5}{6}$ 6. $8 - 1\frac{3}{10}$ 7. $6\frac{1}{5} - \frac{4}{5}$

8. $8 - 6\frac{5}{8}$ 9. $6\frac{1}{3} - 4\frac{7}{12}$ 10. $10\frac{2}{5} - 2\frac{9}{10}$ 11. $16\frac{1}{4} - 5\frac{2}{3}$ 12. $20\frac{5}{16} - 10\frac{5}{8}$

13. $9 - 5\frac{3}{7}$ 14. $8\frac{1}{2} - 2\frac{5}{6}$ 15. $14\frac{3}{8} - 1\frac{3}{16}$ 16. $17\frac{1}{5} - 6\frac{3}{4}$ 17. $18\frac{1}{10} - 12\frac{2}{5}$

UNIT 12

Zero in the quotient. Estimating quotients. Three-figure divisors. Relating multiplication and division

Zero in the quotient

1. In filling out a 4-H Club report, Harry was asked to give the average number of eggs laid by his hens per month.

His records showed that the hens had laid 2,436 eggs during the year.

To find the average number of eggs laid per month, he needed to divide ? by ?.

In the box at the right you see two ways to divide 2,436 by 12. Explain the First Way; the Second Way.

Does the First Way help you to understand the Second Way?

How can you tell that the 2 in the quotient in the Second Way stands for 200?

First Way

$2436 = 2400 + 36$

$2400 \div 12 = 200$
$36 \div 12 = 3$
So $2436 \div 12 = \overline{203}$

Second Way

```
    203
12)2436
   24
     36
     36
```

2. Miss Johnson's sixth-grade class needs \$73.08 to pay expenses of a trip to the State Capital.

There are 36 pupils in the class. To find how much each must earn on the average before they can take the trip, divide ? by ?.

Should each pupil earn about \$1, about \$2, or about \$3?

In the box at the right you see two ways to divide \$73.08 by 36. Explain each way.

First Way

$\$73.08 = \$72.00 + \$1.08$

$\$72.00 \div 36 = \$2.00$
$\$\ 1.08 \div 36 = .03$
So $\$73.08 \div 36 = \overline{\$2.03}$

Second Way

```
     $2.03
36)$73.08
     72
      108
      108
```

3. Tell why the rule below is true.

In every division example, the last figure of the quotient is written directly above the last figure of the dividend.

4. Estimate the quotients in these divisions:

a	*b*	*c*	*d*	*e*
33)6831	21)4284	32)9728	43)8772	52)10608

Where are the mistakes?

Each division below is done correctly; then it is done again showing the mistake that some sixth-grade pupil made.

- *Explain the correct division.*
- *Find the error in the incorrect division.*
- *Copy each example. Work and check it.*

1. RIGHT

```
     308
32)9856
   96
    256
    256
```

WRONG

```
      38
32)9856
   96
    256
    256
```

2. RIGHT

```
     204
36)7344
   72
    144
    144
```

WRONG

```
     2 4
36)7344
   72
    144
    144
```

3. RIGHT

```
      408 r1
56)22849
   224
     449
     448
       1
```

WRONG

```
      48  r1
56)22849
   224
     449
     448
       1
```

4. RIGHT

```
      520 r5
36)18725
   180
     72
     72
      5
```

WRONG

```
      52  r5
36)18725
   180
     72
     72
      5
```

5. RIGHT

```
      650 r18
45)29268
   270
    226
    225
     18
```

WRONG

```
      65  r18
45)29268
   270
    226
    225
     18
```

6. RIGHT

```
      302 r5
35)10575
   105
     75
     70
      5
```

WRONG

```
      32  r5
35)10575
   105
     75
     70
      5
```

7. RIGHT

```
     3005
19)57095
   57
    095
     95
```

WRONG

```
       35
19)57095
   57
    095
     95
```

8. RIGHT

```
      2003
62)124186
   124
     186
     186
```

WRONG

```
       203
62)124186
   124
     186
     186
```

Sensible answers in division

Estimate the answers to these examples. Do not use a pencil.

1. Is 56,480 ÷ 27 less than or more than 2,000?

2. Is 1,743 ÷ 32 a 2-place or a 3-place number?

3. Is 7,846 ÷ 25 closer to 300 or to 400?

4. Is 6,920 ÷ 35 closer to 100 or to 200?

5. Is 2,081 a sensible answer for 14,567 ÷ 7?

6. If you start with 1,600 and subtract 80 over and over, can you do 20 subtractions?

7. Is 14,562 ÷ 75 a number that lies between 100 and 200?

8. Does 534 contain 69 seven times?

9. Which of these is greater: 8 × 76, or 599?

10. Is 28,020 ÷ 14 about 2,000 or 3,000?

11. Does 7,488 ÷ 36 equal 28 or 208?

12. Is 47 a sensible answer for 18,722 ÷ 46?

13. Is 72,036 ÷ 36 about 2,000 or about 200?

14. If 405 × 39 = 15,795, then you know that 15,795 ÷ 39 = __?__.

15. Does $\frac{1}{8}$ of 48,024 amount to more than 6,000?

16. What do the 3's in these divisions stand for?

$\begin{array}{r} 3 \\ 28\overline{)840} \end{array}$ $\qquad$ $\begin{array}{r} 3 \\ 28\overline{)84062} \end{array}$ $\qquad$ $\begin{array}{r} 3 \\ 28\overline{)8406} \end{array}$

17. In each division in Exs. 19–22, tell whether the answer is a 2-place, a 3-place, or a 4-place number. Explain how you know.

18. Estimate each answer in Exs. 19–22. In the first one say, "The answer is a 2-place number. It is about 20."

Divide and check:

	a	*b*	*c*
19.	$45\overline{)906}$	$65\overline{)6630}$	$56\overline{)22425}$
20.	$36\overline{)3820}$	$94\overline{)3008}$	$29\overline{)17610}$
21.	$27\overline{)5508}$	$35\overline{)7095}$	$85\overline{)17016}$
22.	$69\overline{)2760}$	$49\overline{)4209}$	$62\overline{)24810}$

To the Teacher: See Note 4, on page 310.

Dividing by a 3-figure number

1. The pupils in the sixth-grade printing class are going to print 1,000 tickets for the Pitt School Field Day.

$$\begin{array}{r} 4 \\ 250\overline{)1000} \\ 1000 \\ \hline \end{array}$$

If blank tickets come in packs of 250, how many packs of tickets should the pupils buy?

To find out, they divided 1,000 by 250. Explain their division above. It shows they should buy _?_ packs of tickets.

2. If they sell the 1,000 tickets at 25¢ each, how much money will they take in?

3. To estimate the quotient figure in the division example at the right, think:

$$209\overline{)836}$$

"209 is closer to 200 than 300. There are probably as many 209's in 836 as there are 2's in 8. $8 \div 2 = 4$."

Do the division. Is 4 the correct quotient figure?

4. To estimate the quotient figure in this division, think:

$$261\overline{)702}$$

"261 is closer to 300 than 200. There are probably as many 261's in 702 as there are 3's in 7."

Do the division. Is 2 the correct quotient figure?

5. To estimate the quotient figure in this division, think:

$$471\overline{)824}$$

"471 is closer to 500 than 400. There are probably as many 471's in 824 as there are 5's in 8."

Do the division. Is 1 the correct quotient figure?

Tell how you estimate the quotient figure in Exs. 6–7. Then divide and check.

6. $216\overline{)567}$ $\quad 532\overline{)3724}$ $\quad 340\overline{)2040}$

7. $381\overline{)912}$ $\quad 392\overline{)2204}$ $\quad 574\overline{)1043}$

8. Is $4{,}675 \div 350$ more than 10? less than 100? Is the quotient a 2-place number?

9. Is $15{,}970 \div 980$ more than 10? less than 100? Is the quotient a 2-place number?

10. Is $1{,}467 \div 382$ more than 10? How many places will there be in the quotient? Estimate the quotient.

11. Does $28{,}240 \div 140$ equal about 2,000 or about 200?

12. Is 30 a sensible answer to $1{,}068 \div 356$?

13. Is 40 a sensible answer to $11{,}000 \div 275$?

Dividing by a 3-figure number

Study Exs. 1–3. Then copy them and see if you can work them without looking at the book.

Check each example. Is each answer sensible?

1.
$$\begin{array}{r} 2\text{ r}74 \\ 245\overline{)564} \\ 490 \\ \hline 74 \end{array}$$

2.
$$\begin{array}{r} 16\text{ r}118 \\ 317\overline{)5190} \\ 317 \\ \hline 2020 \\ 1902 \\ \hline 118 \end{array}$$

3.
$$\begin{array}{r} 205 \\ 528\overline{)108240} \\ 1056 \\ \hline 2640 \\ 2640 \\ \hline \end{array}$$

4. In each division in Exs. 6–11 tell whether the quotient is a 1-place, 2-place, or 3-place number.

5. Estimate each quotient in Exs. 6–11. In the first one say, "The quotient is a 2-place number. It is probably about 30."

Divide and check:

	a	*b*
6.	$265\overline{)9275}$	$167\overline{)346}$
7.	$285\overline{)6840}$	$423\overline{)1720}$
8.	$359\overline{)8745}$	$223\overline{)1394}$
9.	$289\overline{)29239}$	$506\overline{)435160}$
10.	$365\overline{)87600}$	$613\overline{)554629}$
11.	$425\overline{)129725}$	$768\overline{)313344}$

12. How many cartons are needed for packing 1,152 ball-point pens if the pens are packed 192 to a carton?

13. There are 332 pupils in the Edison School. The principal has 1,000 free book covers.

How many covers can he give each pupil?

14. The principal of the Edison School gave out 2,000 pencils to the 332 pupils during the year.

Each pupil received an average of _?_ pencils.

15. How long would it take a plane flying at an average speed of 150 miles an hour to go 750 miles?

16. There are 144 notebooks in a gross. How many gross of notebooks would be needed to give a notebook to each of the 1,152 pupils in a school?

17. How many packs of tickets, 250 to the pack, would you need to make 1,500 tickets?

Thrifty shopping

A class in homemaking brought to school these shopping problems. Can you tell the answers?

1. Alice asked, "How much can you save by buying a quart of furniture polish in a quart jar for 79¢, instead of buying a quart in half-pint bottles at 29¢ a bottle?"

2. Catherine asked how much cheaper it was to buy a large box of cereal (28 oz.) for 25¢ than to buy 2 small boxes (14 oz.) for 15¢ a box.

3. James asked, "How much can be saved by buying a gallon of paint in a gallon can for $3.49 instead of buying a gallon in quart cans for 98¢ a quart?"

4. Peter said, "The boys in a bird club found they could get a 10-lb. bag of bird feed for $.75, or a 50-lb. bag for $3.00. They estimated that they would use about 50 pounds of the feed.

"How much did the club save by buying 50 pounds in one large bag instead of in smaller bags?"

5. When butter was selling at 61¢ a pound, Janet paid _?_¢ for a quarter pound.

Janet said, "I paid at the rate of 64¢ a pound for that butter." Explain what she meant.

6. Fred told of this experience: He found that he could get one ball of kite string for 15¢, or three balls for 40¢.

The clerk said, "Three balls at 15¢ each would cost _?_ cents. You would save 5¢ by taking our special offer of 3 balls for 40¢."

Fred laughed and said, "Oh, no, I wouldn't. I can use only one ball of string. I would waste 25¢ by taking your special offer of 3 balls for 40¢."

Explain Fred's statement that he would waste 25¢ by taking the special offer.

7. Ann said, "I can get a 10-oz. box of soap flakes for 15¢, or a 22-oz. box for 29¢.

▶ "I figure that soap flakes bought in small boxes would cost me _?_ cents an ounce.

▶ "At the rate of $1\frac{1}{2}$¢ an ounce, 22 oz. of soap flakes would cost me _?_¢.

▶ "22 oz. of soap flakes at the small-box rate would cost _?_¢ more than 22 oz. at the large-box rate."

8. Tell the class about thrifty-shopping problems you have had.

Multiplication and division are related

Tom said that he could make two division problems out of any multiplication problem, like this:

Multiplication Problem: What is the cost of 5 pencils at 6¢ each? *Answer:* 5 × 6¢, or 30¢.

Division Problem I: How many pencils at 6¢ each can you buy for 30¢? *Answer:* The number of pencils = 30¢ ÷ 6¢ = 5.

Division Problem II: If 5 pencils cost 30¢, what is the cost of each pencil? *Answer:* Cost of each is $\frac{1}{5}$ of 30¢, or 30¢ ÷ 5, or 6¢.

1. Tell what two division problems you think Tom would make out of this multiplication problem:

At 75¢ a dozen, what would 4 dozen eggs cost? 4 × 75¢ = 300¢, or $3.00.

2. Use this multiplication to make two division problems:

How many inches are there in 5 yd.? *Answer:* 5 × 36 in. = 180 in.

3. If 5 × 4 = 20, then $\frac{20}{5}$ = _?_

4. If 5 × 4 = 20, then $\frac{20}{4}$ = _?_

5. You know that *multiplier × multiplicand = product.*

To find a missing multiplier, you divide the _?_ by the _?_.

To find a missing multiplicand, you divide the _?_ by the _?_.

6. To find the missing number in 5 × N cents = 75 cents, divide _?_ by _?_.

7. To find the missing number in N × 15 cents = 75 cents, divide _?_ by _?_.

Find the missing multiplier:

8. N × 25 cents = 75 cents

9. N × 12 inches = 108 inches

10. N × 8 gallons = 40 gallons

Find the missing multiplicand:

11. 5 × N dollars = 35 dollars

12. 8 × N inches = 96 inches

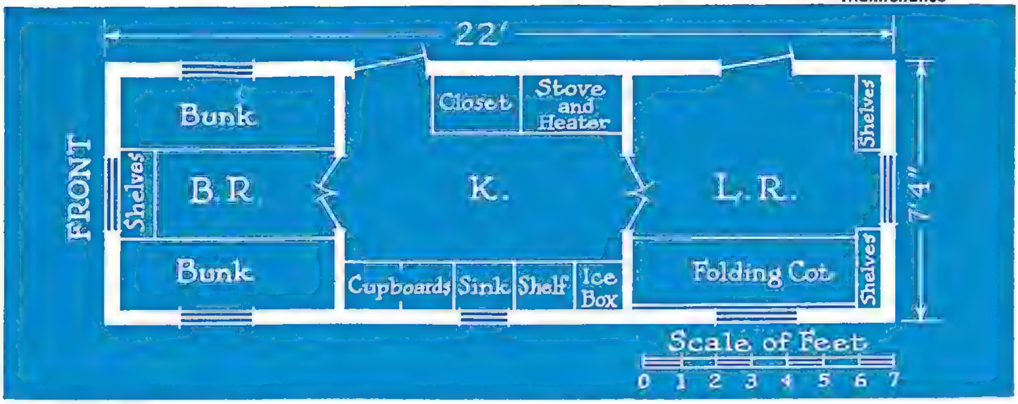
13. 15 × N hours = 90 hours

14. Joe looked at the divisions below. He thought, "The dividends get larger; the divisors remain the same. So the quotients must get _?_."

$2\overline{)16}$ $2\overline{)24}$ $2\overline{)28}$ $2\overline{)76}$ $2\overline{)1500}$

15. Five pupils agreed to share equally the cost of a 75-cent birthday gift for their school bus driver. How much should each pay?

16. How many pupils would have to give 15 cents apiece to collect 75 cents for a birthday gift for the school bus driver?

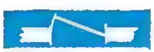


Reading floor plans

Above is a plan of the Byrd family's trailer, which they call Byrds' Nest. Before reading the questions below, study the plan and find out all you can about the trailer.

1. How long is the trailer? How wide? Mark off on your schoolroom floor a rectangle 22 ft. by 7 ft. 4 in.

2. B.R. on the plan stands for bedroom. What does K. stand for on the plan? What does L.R. stand for?

3. A mark like this  indicates a door in a floor plan. Does it look a little like a door standing open?

How many outside doors are there in the trailer?

4. Can you find the two double doors inside the trailer? What is a double door?

5. A mark like this  indicates a window in a floor plan.

How many windows are there in the bedroom? in the kitchen? in the living room?

6. Do you know how a trailer is attached to a car? Is Byrds' Nest attached to the car at the bedroom end or at the living-room end?

7. Has your family ever built a house? If so, can you read the floor plans for it?

Maybe someone can bring some house plans to school for the class to study.

8. Would your class like to try to draw a floor plan of your classroom? What would you have to do before you could draw the plan?

9. Have you ever used a plan for building anything? If so, what did you build?

A page of review

Add and check:

	a	b	c	d	e	f
1.	46 39 87 54	39 87 63 92	465 83 946 54	308 97 65 493	\$1.56 2.84 .09 .32	\$2.46 .97 5.60 .78
2.	$\frac{3}{10}$ $\frac{7}{10}$	$\frac{2}{3}$ $\frac{5}{6}$	$\frac{3}{4}$ $\frac{2}{3}$	$1\frac{3}{4}$ $2\frac{5}{8}$	$3\frac{5}{6}$ $4\frac{1}{4}$	$2\frac{7}{10}$ $4\frac{1}{2}$

Subtract and check:

3.	946 828	756 297	806 378	1500 987	\$16.94 3.77	\$9.00 2.84
4.	$\frac{7}{8}$ $\frac{5}{8}$	$\frac{2}{3}$ $\frac{1}{6}$	$4\frac{4}{5}$ $1\frac{1}{2}$	9 $\frac{7}{8}$	$8\frac{1}{2}$ $1\frac{2}{3}$	$9\frac{1}{4}$ $2\frac{2}{3}$

Multiply and check:

5.	670 58	597 70	486 39	563 204	604 287	\$5.07 56

Divide and check:

	a	b	c	d	e
6.	7)2798	48)7984	82)3856	26)7389	35)\$82.25
7.	8)3546	23)9476	76)3496	32)6944	48)\$79.20

8. Robert got 30 pounds of honey from his beehive, and his brother Al got $26\frac{3}{4}$ pounds from his. Robert said, "My bees made _?_ more pounds of honey than yours."

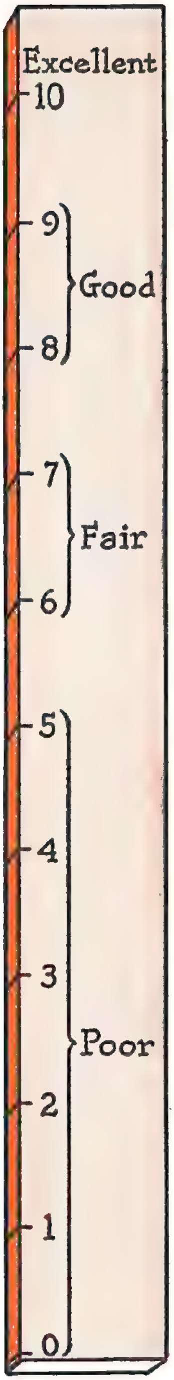
9. Write in figures: 5 billion, 850 million, 50 thousand.

10. A raft $8\frac{1}{2}$ ft. long is how much longer than a raft $6\frac{3}{4}$ ft. long?

11. If Harold buys 8 doz. lead pencils for \$2.88 and sells them at 5¢ each, how much will he make?

12. If paper cups sell at 30¢ a hundred, what will 500 cups cost?

Problem Test 1



The measuring stick at the left will help you measure your growth in problem solving.

1. A football team scored a total of 144 points in 9 games. That was an average of _?_ points per game.

2. Lester has $11.23. If he pays $6.98 for a plaid flannel shirt, how much will he have left?

3. Marie had 72¢ in her purse. Later, when she looked, she had only 22¢. She said, "I've lost a _?_ dollar."

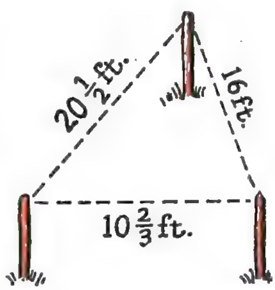
4. Dan's father gives him an allowance of $.35 a week. How much does that amount to in a year?

5. Thomas bought a magnet for 69¢, a flashlight bulb for 5¢, and 3 flashlight batteries at 9¢ each. He spent _?_.

6. 15 boys were paid $6.00 for digging a ditch. If they share the money equally, how much will each boy get?

7. How many 24-inch lengths can be cut from a piece of canvas 30 feet long?

8. Will a 50-foot piece of clothesline be long enough for Ellen to stretch between these 3 posts? To fasten the line she needs two extra feet.



9. If $2\frac{7}{8}$ yd. are cut from $18\frac{1}{4}$ yd. of rope, how many yards will be left?

10. Each of the 23 girls in a class knit 7 squares for the Junior Red Cross. How many more squares does the class need for a blanket of 168 squares?

In this book there are 8 Problem Tests. Keep a record of your score on each test. Start your record by writing in it the score you make on this test.

Arithmetic roundup

▶ Oral review

1. Change to simplest form:

$\frac{10}{12}$ $\frac{12}{8}$ $\frac{5}{3}$ $\frac{10}{20}$ $\frac{28}{8}$

2. $\frac{1}{2}=\frac{?}{6}$ $\frac{3}{8}=\frac{?}{16}$ $\frac{3}{4}=\frac{?}{12}$

3. $\frac{3}{10}+\frac{2}{5}=?$ $\frac{7}{10}+\frac{1}{5}=?$ $\frac{1}{6}+\frac{1}{4}=?$

4. $\frac{7}{8}-\frac{3}{8}=?$ $\frac{11}{12}-\frac{1}{3}=?$ $\frac{1}{3}-\frac{1}{4}=?$

5. $1-\frac{7}{8}=?$ $3-\frac{4}{5}=?$ $8-\frac{5}{6}=?$

6. What should you add to $3\frac{5}{8}$ to make 10?

7. Add 7 to each of these five numbers:

37 45 26 68 59

8. Subtract 9 from each number in Ex. 7.

9. Multiply each number in Ex. 7 by 8.

10. Estimate the average of: 10, 6, 20, 11, 8. Then find the exact average.

11. Does $338 \div 26 = 13$ or 103?

12. Does $5{,}568 \div 24 = 322$, or 23, or 232?

13. The more equal parts into which you cut a cake, the _?_ each piece will be.

▶ Written review

1.
$$\begin{array}{r} 4635 \\ 908 \\ 7439 \\ 6020 \\ 759 \\ \hline \end{array}$$

2.
$$\begin{array}{r} \$.35 \\ .60 \\ .74 \\ .86 \\ .95 \\ \hline \end{array}$$

3.
$$\begin{array}{r} 50762 \\ -\ 943 \\ \hline \end{array}$$

4.
$$\begin{array}{r} \$90.00 \\ -\ 28.76 \\ \hline \end{array}$$

5.
$$\begin{array}{r} 435 \\ \times\ 800 \\ \hline \end{array}$$

6.
$$\begin{array}{r} 507 \\ \times\ 985 \\ \hline \end{array}$$

7. Divide 26,358 by 305.

8. Add: $5\frac{3}{10} + 4\frac{1}{2} + 1\frac{3}{5}$.

9. Subtract $6\frac{4}{5}$ from 10.

10. Bill wants a Scout uniform that costs $6.50. He has $4.83. He needs _?_ more.

11. Which of these do not equal a billion?

- 1,000 million
- 500,000,000 + 500,000,000
- 99,000,000 + 1,000,000
- 2×1 million
- $10 \times 100{,}000{,}000$

Measuring your growth in arithmetic

Work carefully. Check your answers. Be sure each answer is sensible.

1.
$$\begin{array}{r} \$46.23 \\ 84.90 \\ 5.67 \\ 35.82 \\ \underline{69.38} \end{array}$$

2.
$$\begin{array}{r} \$1480.75 \\ \underline{-\ 974.67} \end{array}$$

3.
$$\begin{array}{r} 5063 \\ \underline{\times\ 67} \end{array}$$

4. Divide 1,573 by 460.

5. Find the average of 45, 50, 75, 35, and 75.

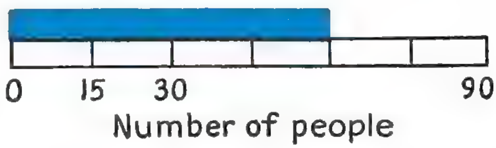
6. Find the sum of $3\frac{1}{2}$ and $6\frac{5}{8}$.

7. Subtract $2\frac{5}{8}$ from $7\frac{1}{4}$.

8. Write in figures the number 5 billion, 286 million, 46 thousand, 7 hundred thirty-two.

9. Subtract $2\frac{3}{4}$ from 5. Then make a drawing to prove that your answer is right.

10. Jean made a bar graph. She pasted numbers along the bottom of it.



Three numbers have fallen off Jean's graph so that the bottom of the graph now looks as it appears above. What numbers have fallen off?

Just for fun

1. Tom has the five pieces of chain shown below. He wants them joined together to make a chain for his puppy.

The blacksmith told Tom he would charge 1¢ to cut a link and 3¢ to weld a link. So it would cost 16¢ to do the job.

Tom said, "You could do it so that my bill would be only 12¢."

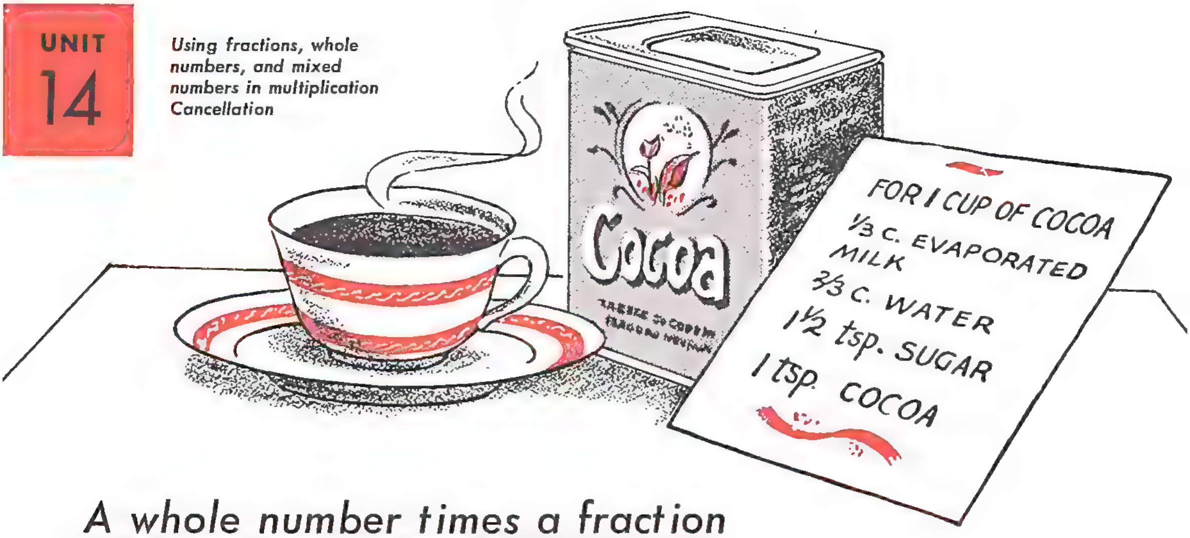
Can you show that Tom was right?

2. A radio singer in New York, who was getting a salary of \$400 a month, had a brother singer in Chicago who was getting a salary of \$375 a month, and three brother singers in St. Louis whose salaries were \$250, \$225, and \$200 a month.

But the singer in Chicago had no brother who was getting a higher salary than he was. Can you explain it?

UNIT 14

Using fractions, whole numbers, and mixed numbers in multiplication
Cancellation



A whole number times a fraction

1. How much evaporated milk should Wendy use for 1 cup of cocoa? for 5 cups of cocoa?

2. Wendy found how much milk to use for 5 cups of cocoa in these 3 ways. Explain each way.

- $\frac{1}{3}+\frac{1}{3}+\frac{1}{3}+\frac{1}{3}+\frac{1}{3}=\frac{?}{3}=$ _?_ cups
- 5×1 third $= 5$ thirds $=$ _?_ cups
- $5 \times \frac{1}{3}=\frac{5 \times 1}{3}=\frac{5}{3}=$ _?_ cups

3. In 3 different ways Wendy found she needs _?_ cups of milk for her 5 cups of cocoa.

Wendy's last way is the shortest way. She *multiplied a fraction by a whole number.*

4. How much water should Wendy use for 1 cup of cocoa?

In 3 ways find how much water she should use for 5 cups of cocoa.

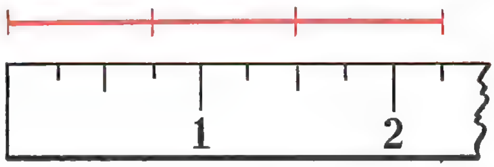
5. 5×3 fourths $=$ _?_ fourths

$$5 \times \frac{3}{4}=\frac{5 \times 3}{4}=\frac{?}{4}=?$$

6. 5×5 sixths $=$ _?_ sixths

$$5 \times \frac{5}{6}=\frac{5 \times 5}{6}=\frac{?}{6}=?$$

7. $12 \times \frac{3}{8}=\frac{12 \times 3}{8}=\frac{?}{8}=4\frac{4}{8}=4\frac{?}{2}$



8. The red line above this ruler shows that:

- $2 \times \frac{3}{4}$ in. $=\frac{2 \times 3}{4}=\frac{?}{4}=$ _?_ inches
- $3 \times \frac{3}{4}$ in. $=\frac{3 \times 3}{4}=\frac{?}{4}=$ _?_ inches

9. Make a rule for finding a whole number times a fraction.

Multiply:

10.	$6 \times \frac{2}{7}$	$7 \times \frac{3}{4}$	$4 \times \frac{2}{5}$
11.	$9 \times \frac{2}{3}$	$6 \times \frac{1}{8}$	$5 \times \frac{6}{7}$
12.	$8 \times \frac{2}{3}$	$3 \times \frac{4}{5}$	$8 \times \frac{5}{6}$
13.	$5 \times \frac{2}{5}$	$6 \times \frac{2}{3}$	$10 \times \frac{4}{5}$

A whole number times a mixed number

1. In making cocoa, Frances used $1\frac{1}{2}$ teaspoonfuls of sugar for each cup.

To find how much sugar to use for 5 cups, she thought, "$5 \times \frac{1}{2} = 2\frac{1}{2}$; and $5 \times 1 = 5$. So I'll need _?_ teaspoonfuls."

$$\boxed{\begin{array}{r} 1\frac{1}{2} \\ \times\ 5 \\ \hline 2\frac{1}{2} \\ 5 \\ \hline 7\frac{1}{2} \end{array}}$$

2. To find $6 \times 2\frac{1}{4}$, Ed thought:

$6 \times \frac{1}{4} = \frac{6}{4} = 1\frac{1}{2}$
$6 \times 2 = 12$
so $6 \times 2\frac{1}{4} = 1\frac{1}{2} + 12$, or _?_

3. To find $12 \times 4\frac{2}{3}$, Ed thought:

$12 \times \frac{2}{3} = 8$
$12 \times 4 = 48$
so $12 \times 4\frac{2}{3} =$ _?_

4. To find $10 \times 2\frac{3}{8}$, Ed thought:

$10 \times \frac{3}{8} =$ _?_
$10 \times 2 =$ _?_
so $10 \times 2\frac{3}{8} =$ _?_ + _?_ = _?_

5. Make a rule for finding a whole number times a mixed number.

6. Copy these examples without the work. Multiply. Then look to see if your work is correct.

$$\begin{array}{r} 2\frac{2}{3} \\ \times\ 6 \\ \hline 4 \\ 12 \\ \hline 16 \end{array} \qquad \begin{array}{r} 1\frac{3}{5} \\ \times\ 5 \\ \hline 3 \\ 5 \\ \hline 8 \end{array} \qquad \begin{array}{r} 2\frac{3}{4} \\ \times\ 8 \\ \hline 6 \\ 16 \\ \hline 22 \end{array} \qquad \begin{array}{r} 12\frac{1}{4} \\ \times\ 9 \\ \hline 2\frac{1}{4} \\ 108 \\ \hline 110\frac{1}{4} \end{array}$$

Estimate the answers to Exs. 7–14. Begin this way:

- $12\frac{1}{2}$ is more than 12 and less than 13. So $2 \times 12\frac{1}{2}$ is more than 24 and less than 26.
- $8\frac{1}{4}$ is more than 8 and less than 9. So $6 \times 8\frac{1}{4}$ is more than 48 and less than 54. Is it closer to 48 than to 54?

	a	*b*	*c*
7.	$2 \times 12\frac{1}{2}$	$6 \times 8\frac{1}{4}$	$7 \times 5\frac{3}{4}$
8.	$3 \times 13\frac{1}{3}$	$8 \times 13\frac{2}{3}$	$8 \times 12\frac{1}{4}$
9.	$4 \times 7\frac{1}{4}$	$9 \times 12\frac{1}{3}$	$8 \times 15\frac{7}{8}$
10.	$6 \times 12\frac{1}{2}$	$8 \times 12\frac{3}{4}$	$6 \times 33\frac{1}{3}$
11.	$3 \times 3\frac{5}{6}$	$6 \times 10\frac{7}{8}$	$8 \times 12\frac{1}{2}$
12.	$5 \times 37\frac{1}{2}$	$9 \times 13\frac{1}{2}$	$6 \times 16\frac{1}{4}$
13.	$7 \times 6\frac{2}{3}$	$6 \times 16\frac{2}{3}$	$6 \times 14\frac{3}{4}$
14.	$9 \times 7\frac{5}{6}$	$4 \times 18\frac{4}{5}$	$7 \times 36\frac{5}{8}$

15. Copy and multiply Exs. 7–14. Be sure your answers are sensible.

16. If $1\frac{1}{4}$ cups of water should be added to 1 can of soup, how much water should be added to 3 cans?

17. A pudding recipe requires $2\frac{1}{4}$ cups of milk. How much milk should be used to make twice the recipe?

Finding a part of a fraction

1. Gordon needs 2 rope hinges for a toolbox. He has $\frac{1}{2}$ yd. of rope.
If he cuts the rope in half, what part of a yard will he have for each hinge? Use a piece of string to prove your answer.

2. Into how many equal parts is Figure 1 divided?

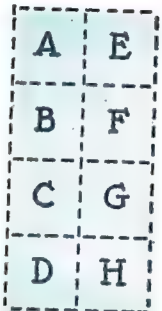


Figure 1

3. What part of Figure 1 do you tear off if you tear off A? A and B? A, B, C, and D?

4. Do $\frac{1}{2}$ of parts A, B, C, and D equal parts A and B?

5. Does $\frac{1}{2}$ of $\frac{1}{2}$ of Figure 1 equal $\frac{1}{4}$ of Figure 1? Does $\frac{1}{2}$ of $\frac{1}{2} = \frac{1}{4}$?

6. Use Figure 1 to show that $\frac{1}{2}$ of $\frac{1}{4} = \frac{1}{8}$; that $\frac{1}{4}$ of $\frac{1}{2} = \frac{1}{8}$.

7. Into how many equal parts is Figure 2 divided?

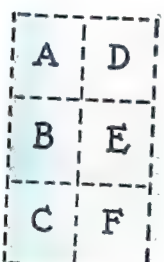


Figure 2

8. What part of Figure 2 do you tear off if you tear off A? A, B, and C?

9. Does $\frac{1}{3}$ of parts A, B, and C equal part A? Does $\frac{1}{3}$ of $\frac{1}{2} = \frac{1}{6}$?
Show that $\frac{1}{2}$ of $\frac{1}{3} = \frac{1}{6}$.

10. Claire has a recipe calling for $\frac{3}{4}$ cup of molasses. She wants to use only $\frac{1}{3}$ of the recipe. How much molasses should she use?
Use a measuring cup to prove your answer.

11. $\frac{1}{2}$ of 6 inches = ? inches
$\frac{1}{2}$ of 6 eighths = ? eighths
$\frac{1}{2}$ of $\frac{6}{8} = \frac{?}{8}$

12. $\frac{1}{2}$ of 4 yards = ? yards
$\frac{1}{2}$ of 4 fifths = ? fifths
$\frac{1}{2}$ of $\frac{4}{5} = \frac{?}{5}$

13. $\frac{1}{3}$ of 6 dollars = ? dollars
$\frac{1}{3}$ of 6 eighths = ? eighths
$\frac{1}{3}$ of $\frac{6}{8} = \frac{?}{8}$

14. $\frac{1}{3}$ of 9 quarts = ? quarts
$\frac{1}{3}$ of 9 tenths = ? tenths
$\frac{1}{3}$ of $\frac{9}{10}$ = ?

15. Show how these statements are illustrated in Figure 3.

- $\frac{1}{2}$ of $\frac{1}{4} = \frac{1}{8}$
- $\frac{1}{4}$ of $\frac{1}{2} = \frac{1}{8}$
- $\frac{1}{2}$ of $\frac{3}{4} = \frac{3}{8}$
- $\frac{3}{4}$ of $\frac{1}{2} = \frac{3}{8}$

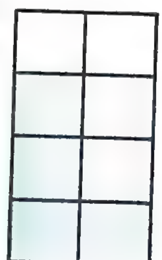


Figure 3

16. What part of this circle is colored? $\frac{1}{2}$ of the colored part is what part of the whole circle? $\frac{1}{2}$ of $\frac{4}{5} = \frac{?}{5}$

Parts of fractions

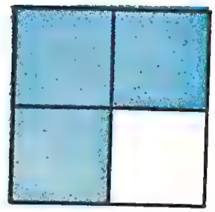


Figure A

1. How many fourths of Figure A are colored?

2. Point to $\frac{1}{3}$ of $\frac{3}{4}$ of the square.

3. Point to $\frac{2}{3}$ of $\frac{3}{4}$ of the square.

4. Show on Figure A that $\frac{2}{3}$ of $\frac{3}{4} = \frac{2}{4} = \frac{1}{2}$.

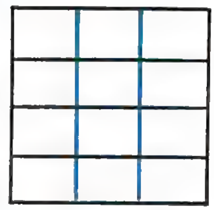


Figure B

5. The blue lines divide Figure B into _?_ equal parts. Point to $\frac{1}{3}$ of the square; $\frac{2}{3}$ of it.

6. The black lines divide Figure B into _?_ equal parts. Point to $\frac{1}{4}$ of the square; $\frac{2}{4}$ of it; $\frac{3}{4}$ of it.

7. The blue lines and the black lines together divide Figure B into _?_ equal parts. Point to $\frac{1}{12}$ of the square; $\frac{2}{12}$; $\frac{3}{12}$; $\frac{6}{12}$.

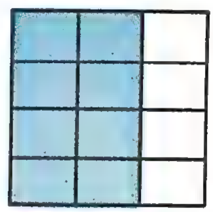


Figure C

8. How many thirds of Figure C are colored? Point to $\frac{1}{4}$ of the colored part; $\frac{2}{4}$ of the colored part; $\frac{3}{4}$ of the colored part.

9. Point to $\frac{1}{4}$ of $\frac{2}{3}$ of Figure C. Is $\frac{1}{4}$ of $\frac{2}{3}$ of Figure C equal to $\frac{2}{12}$ of Figure C?

10. Point to $\frac{3}{4}$ of $\frac{2}{3}$ of Figure C. Show that $\frac{3}{4}$ of $\frac{2}{3}$ of Figure C is equal to $\frac{1}{2}$ of Figure C.

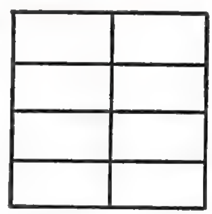


Figure D

11. Use Figure C to show that $\frac{3}{4}$ of $\frac{2}{3} = \frac{1}{2}$.

12. In Ex. 4 you showed that $\frac{2}{3}$ of $\frac{3}{4} = \frac{1}{2}$.
In Ex. 11 you showed that $\frac{3}{4}$ of $\frac{2}{3} = \frac{1}{2}$.
Does $\frac{2}{3}$ of $\frac{3}{4} = \frac{3}{4}$ of $\frac{2}{3}$?

13. Use Figure D to show that $\frac{1}{2}$ of $\frac{1}{4} = \frac{1}{4}$ of $\frac{1}{2}$.

14. Use Figure D to show that $\frac{3}{4}$ of $\frac{1}{2} = \frac{1}{2}$ of $\frac{3}{4}$.

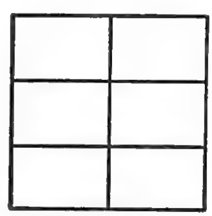


Figure E

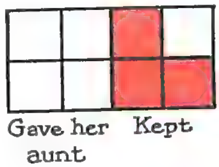
15. Use Figure E to show that $\frac{1}{2}$ of $\frac{1}{3} = \frac{1}{3}$ of $\frac{1}{2}$.

16. Use Figure E to show that $\frac{1}{2}$ of $\frac{2}{3} = \frac{2}{3}$ of $\frac{1}{2}$.

To the Teacher: See Note 5 on page 310.

A fraction times a fraction

▶ Shirley baked a cake for strawberry shortcake. She cut it into 8 squares, as shown in this diagram.

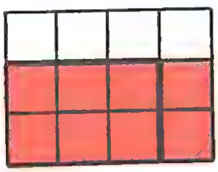


She gave $\frac{1}{2}$ of the cake to her aunt. She kept $\frac{1}{2}$ herself.

She served $\frac{3}{4}$ of her half for dinner.

What part of the whole cake did she serve for dinner? Each small square is what part of the whole cake? How many small squares did Shirley serve? $\frac{3}{4}$ of $\frac{1}{2} = \frac{3}{8}$.

▶ What part of this rectangle is colored?



What part of the colored part is enclosed in the heavy line?

What part of the whole rectangle is enclosed in the heavy line? $\frac{3}{4}$ of $\frac{2}{3} = \frac{6}{12} = \frac{1}{2}$

Instead of saying "$\frac{3}{4}$ of $\frac{2}{3}$", we sometimes say "$\frac{3}{4}$ times $\frac{2}{3}$."

$$\boxed{\frac{3}{4} \times \frac{2}{3} = \frac{3 \times 2}{4 \times 3} = \frac{6}{12} = \frac{1}{2}}$$

Notice that to find $\frac{3}{4}$ of $\frac{2}{3}$, we first multiply the two numerators (3 and 2) to get the numerator of the answer. Then we multiply the two denominators (4 and 3) to get the denominator of the answer.

To multiply fractions, multiply the numerators, and then multiply the denominators.

1. Copy these examples without the work and do them. Then look to see if your answers are right.

- $\frac{2}{3}$ of $\frac{3}{4} = \frac{2}{3} \times \frac{3}{4} = \frac{2 \times 3}{3 \times 4} = \frac{6}{12} = \frac{1}{2}.$
- $\frac{2}{3}$ of $\frac{2}{3} = \frac{2}{3} \times \frac{2}{3} = \frac{2 \times 2}{3 \times 3} = \frac{4}{9}.$
- $\frac{3}{4}$ of $\frac{5}{6} = \frac{3}{4} \times \frac{5}{6} = \frac{3 \times 5}{4 \times 6} = \frac{15}{24} = \frac{5}{8}.$

Find these answers:

	a	b	c	d	e
2.	$\frac{1}{2}$ of $\frac{5}{6}$	$\frac{1}{8} \times \frac{3}{5}$	$\frac{6}{9} \times \frac{3}{2}$	$\frac{1}{7} \times \frac{2}{3}$	$\frac{2}{3}$ of $\frac{4}{5}$
3.	$\frac{3}{4}$ of $\frac{2}{3}$	$\frac{3}{8} \times \frac{1}{5}$	$\frac{4}{5} \times \frac{5}{4}$	$\frac{1}{8} \times \frac{3}{5}$	$\frac{1}{4}$ of $\frac{3}{5}$
4.	$\frac{1}{6}$ of $\frac{1}{2}$	$\frac{7}{10} \times \frac{3}{4}$	$\frac{1}{2} \times \frac{7}{9}$	$\frac{3}{8} \times \frac{2}{5}$	$\frac{4}{5}$ of $\frac{1}{3}$
5.	$\frac{3}{8}$ of $\frac{1}{4}$	$\frac{5}{7} \times \frac{2}{3}$	$\frac{3}{4} \times \frac{5}{6}$	$\frac{2}{9} \times \frac{2}{3}$	$\frac{3}{4}$ of $\frac{1}{6}$

A fraction times a whole number

1. How much will you pay for $\frac{3}{4}$ doz. rolls at 20¢ a dozen? Will you pay $\frac{3}{4}$ of 20¢?

In finding $\frac{3}{4}$ of 20¢, which solution below seems easier? (In the second solution, why can you write $\frac{20}{1}$ instead of 20?

- $\frac{1}{4}$ of $20=5$; so $\frac{3}{4}$ of $20=3\times5=15$
- $\frac{3}{4}$ of $20 = \frac{3}{4}\times\frac{20}{1}=\frac{3\times20}{4\times1}=\frac{60}{4}=15$

2. Which method in Ex. 1 would be easier if you were finding the cost of $\frac{3}{4}$ doz. rolls at 25¢ a dozen? Why?

Use both methods shown in Ex. 1 to do these multiplications:

	a	b	c
3.	$\frac{3}{4}\times 32$	$\frac{3}{4}\times 15$	$\frac{3}{5}\times 60$
4.	$\frac{2}{3}\times 13$	$\frac{4}{5}\times 15$	$\frac{3}{7}\times 20$
5.	$\frac{2}{3}\times 25$	$\frac{2}{5}\times 14$	$\frac{2}{5}\times 8$

Choose the easier method to do each of the multiplications in Exs. 6–13:

	a	b	c
6.	$\frac{5}{6}\times 10$	$\frac{3}{4}\times 21$	$\frac{3}{8}\times 10$
7.	$\frac{5}{8}\times 13$	$\frac{2}{3}\times 27$	$\frac{7}{8}\times 56$
8.	$\frac{2}{3}\times 24$	$\frac{4}{5}\times 27$	$\frac{5}{6}\times 32$
9.	$\frac{3}{4}\times 17$	$\frac{4}{5}\times 18$	$\frac{3}{4}\times 35$
10.	$\frac{7}{8}\times 16$	$\frac{3}{8}\times 15$	$\frac{7}{8}\times 18$
11.	$\frac{4}{5}\times 9$	$\frac{2}{3}\times 18$	$\frac{2}{5}\times 12$
12.	$\frac{3}{5}\times 21$	$\frac{2}{5}\times 16$	$\frac{4}{5}\times 22$
13.	$\frac{5}{8}\times 12$	$\frac{3}{8}\times 64$	$\frac{5}{6}\times 42$

14. Find the cost of $\frac{3}{4}$ lb. of candy at 60¢ a pound; at 50¢ a pound.

15. What is $\frac{5}{6}$ of 54? $\frac{5}{6}$ of 28?

First estimate each product in Exs. 16–21 this way: $\frac{1}{3}$ of 10 is a little more than 3; so $\frac{2}{3}$ of 10 is more than 6.

Then multiply and check to see if each answer is sensible.

	a	b	c
16.	$\frac{2}{3}$ of 10	$\frac{3}{4}$ of 9	$\frac{5}{8}$ of 20
17.	$\frac{3}{8}$ of 17	$\frac{5}{6}$ of 19	$\frac{4}{9}$ of 39
18.	$\frac{2}{3}$ of 17	$\frac{3}{4}$ of 19	$\frac{3}{5}$ of 18
19.	$\frac{3}{4}$ of 29	$\frac{5}{9}$ of 40	$\frac{2}{3}$ of 5
20.	$\frac{2}{3}$ of 100	$\frac{3}{4}$ of 10	$\frac{4}{5}$ of 14
21.	$\frac{7}{8}$ of 25	$\frac{2}{3}$ of 16	$\frac{3}{10}$ of 35

22. Do these two multiplications show that $\frac{5}{6}\times 10 = 10\times\frac{5}{6}$?

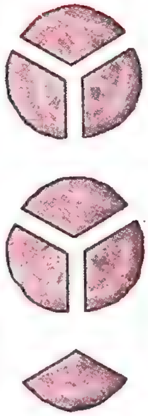
- $\frac{5}{6}\times 10=\frac{5}{6}\times\frac{10}{1}=\frac{5\times10}{6\times1}=\frac{?}{6}=\underline{?}$
- $10\times\frac{5}{6}=\frac{10}{1}\times\frac{5}{6}=\frac{10\times5}{1\times6}=\frac{50}{?}=\underline{?}$

23. Show that $\frac{2}{3}\times 8 = 8\times\frac{2}{3}$.

24. Show that $\frac{3}{4}\times 9 = 9\times\frac{3}{4}$.

Mixed numbers and improper fractions

1. Mary cut each of the pies she baked for her party into 3 servings.



After the party she had 7 servings or 7 thirds left, as shown by the drawing.

Which statements below are illustrated by the drawing?

- $1 = \frac{3}{3}$
- $\frac{4}{3} = 1\frac{1}{3}$
- $2 = \frac{6}{3}$
- $\frac{5}{3} = 1\frac{2}{3}$
- $2\frac{1}{3} = \frac{7}{3}$
- $\frac{8}{3} = 2\frac{2}{3}$

2. The mixed number $2\frac{1}{3}$ is equal to the improper fraction _?_.

3. Without the help of a drawing, how would you change $2\frac{1}{3}$ to thirds?

4. How would you change $1\frac{2}{3}$ to thirds?

5. One of these statements is incorrect. Which one is it?

- $\frac{5}{4} = 1\frac{1}{4}$
- $\frac{7}{4} = \frac{4}{4} + \frac{3}{4}$
- $2\frac{3}{4} = \frac{8+3}{4} = \frac{11}{4}$
- $\frac{9}{4} = \frac{4}{4} + \frac{4}{4} + 1$

6. To change $2\frac{3}{4}$ to fourths, multiply **4** by _?_, and add _?_; write the sum over 4. The result is _?_.

7. To change $\frac{11}{4}$ to a mixed number, divide 11 by _?_. The quotient is _?_, and the remainder expressed as a fraction is _?_; so $\frac{11}{4}$ = _?_.

8. Make a rule for changing a mixed number to an improper fraction. Illustrate how to use this rule.

9. Make a rule for changing an improper fraction to a mixed number. Illustrate how to use this rule.

Change these mixed numbers to improper fractions:

	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*
10.	$3\frac{5}{6}$	$2\frac{2}{3}$	$9\frac{3}{5}$	$2\frac{3}{8}$	$4\frac{2}{7}$	$7\frac{4}{5}$	$8\frac{1}{8}$	$2\frac{1}{7}$
11.	$6\frac{5}{9}$	$5\frac{7}{10}$	$5\frac{3}{8}$	$9\frac{3}{4}$	$6\frac{1}{8}$	$8\frac{1}{3}$	$10\frac{2}{9}$	$7\frac{7}{8}$

Change these improper fractions to whole or mixed numbers:

12.	$\frac{9}{5}$	$\frac{13}{5}$	$\frac{17}{5}$	$\frac{9}{2}$	$\frac{9}{3}$	$\frac{15}{4}$	$\frac{7}{3}$	$\frac{12}{4}$
13.	$\frac{9}{4}$	$\frac{19}{6}$	$\frac{10}{3}$	$\frac{7}{2}$	$\frac{8}{3}$	$\frac{11}{3}$	$\frac{15}{2}$	$\frac{19}{4}$

A multiplication short cut

1. Peter wanted to reduce $\frac{6}{12}$ to lowest terms. He wrote: ⟶

$$\boxed{\frac{\overset{1}{\cancel{6}}}{\underset{2}{\cancel{12}}} = \frac{1}{2}}$$

He crossed out, or ***canceled,*** the 6, and wrote a 1 above it. What did he do to the 12?

Do you see that Peter divided both the numerator and the denominator by 6? In order to reduce the fraction to lowest terms, he used ***cancellation.***

2. To reduce $\frac{8}{12}$ to lowest terms, Peter wrote: ⟶

$$\boxed{\frac{\overset{2}{\cancel{8}}}{\underset{3}{\cancel{12}}} = \frac{2}{3}}$$

He divided both the numerator, 8, and the denominator, 12, by _?_. He reduced $\frac{8}{12}$ to $\frac{?}{?}$.

3. Explain how Peter and Jane found $\frac{3}{8} \times \frac{4}{5}$. Here is their work:

PETER

$$\frac{3}{\underset{2}{\cancel{8}}} \times \frac{\overset{1}{\cancel{4}}}{5} = \frac{3 \times 1}{2 \times 5} = \frac{3}{10}$$

JANE

$$\frac{3}{8} \times \frac{4}{5} = \frac{3 \times 4}{8 \times 5} = \frac{12}{40} = \frac{3}{10}$$

How does Jane's way differ from Peter's? Whose way is easier?

4. To find $\frac{3}{5}$ of $\frac{10}{21}$, Peter wrote:

$$\frac{\overset{1}{\cancel{3}}}{\underset{1}{\cancel{5}}} \times \frac{\overset{2}{\cancel{10}}}{\underset{7}{\cancel{21}}} = \frac{1 \times 2}{1 \times 7} = \frac{2}{7}$$

Peter divided the 3 and the 21 each by _?_. Then he divided the 10 and the 5 each by _?_.

In multiplication of fractions, a numerator and a denominator may be divided by the same number. This is called *cancellation.*

In each of these examples tell by what number a numerator and a denominator are both divided. (In Ex. 6, notice that $5 \times \frac{3}{5}$ *is written* $\frac{5}{1} \times \frac{3}{5}$*. Does* $5 = \frac{5}{1}$*?)*

Copy the examples; then work them without looking at the book.

5. $\frac{\overset{1}{\cancel{5}}}{6} \times \frac{1}{\underset{1}{\cancel{5}}} = \frac{1}{6}$

6. $5 \times \frac{3}{5} = \frac{\overset{1}{\cancel{5}}}{1} \times \frac{3}{\underset{1}{\cancel{5}}} = 3$

7. $8 \times \frac{3}{4} = \frac{\overset{2}{\cancel{8}}}{1} \times \frac{3}{\underset{1}{\cancel{4}}} = \frac{6}{1} = 6$

8. $\frac{\overset{1}{\cancel{5}}}{\underset{4}{\cancel{8}}} \times \frac{\overset{1}{\cancel{2}}}{\underset{1}{\cancel{5}}} = \frac{1}{4}$

9. $\frac{3}{8} \times 4 = \frac{3}{\underset{2}{\cancel{8}}} \times \frac{\overset{1}{\cancel{4}}}{1} = \frac{3}{2} = 1\frac{1}{2}$

10. $\frac{\overset{1}{\cancel{3}}}{\underset{2}{\cancel{8}}} \times \frac{\overset{1}{\cancel{4}}}{\underset{3}{\cancel{9}}} = \frac{1}{6}$

Cancellation practice

Multiply, canceling wherever possible. In some examples you can cancel twice, as shown in Ex. 4, page 93.

Be sure that in every pair of cancellations you divide one numerator and one denominator by the same number.

	a	b	c	d	e
1.	$\frac{10}{12} \times \frac{3}{5}$	$\frac{2}{3} \times \frac{1}{4}$	$\frac{5}{6} \times \frac{2}{2}$	$\frac{16}{1} \times \frac{5}{6}$	$\frac{5}{9} \times \frac{18}{20}$
2.	$\frac{6}{18} \times \frac{3}{4}$	$\frac{7}{12} \times 30$	$\frac{8}{9} \times \frac{27}{1}$	$\frac{2}{12} \times \frac{3}{5}$	$\frac{3}{4} \times 40$
3.	$\frac{20}{1} \times \frac{2}{5}$	$\frac{3}{5} \times \frac{5}{6}$	$\frac{3}{4} \times \frac{32}{33}$	$21 \times \frac{4}{7}$	$\frac{5}{12} \times \frac{1}{4}$
4.	$\frac{7}{10} \times \frac{2}{5}$	$\frac{3}{4} \times 12$	$\frac{5}{6} \times \frac{15}{40}$	$\frac{24}{1} \times \frac{2}{9}$	$\frac{3}{4} \times 24$
5.	$\frac{3}{16} \times \frac{2}{3}$	$\frac{2}{5} \times 20$	$\frac{2}{3} \times \frac{4}{5}$	$28 \times \frac{4}{7}$	$\frac{2}{3} \times \frac{11}{12}$
6.	$\frac{5}{16} \times \frac{4}{5}$	$\frac{5}{6} \times 16$	$\frac{5}{6} \times \frac{1}{4}$	$\frac{5}{8} \times 48$	$\frac{5}{9} \times \frac{2}{3}$

7. Which of these three ways of finding $\frac{2}{3} \times \frac{3}{4}$ do you prefer?

- $\frac{2}{3} \times \frac{3}{4} = \frac{6}{12} = \frac{1}{2}$
- $\frac{\overset{1}{\cancel{2}}}{\underset{1}{\cancel{3}}} \times \frac{\overset{1}{\cancel{3}}}{\underset{2}{\cancel{4}}} = \frac{1}{2}$
- $\frac{1}{3}$ of $\frac{3}{4} = \frac{1}{4}$; so $\frac{2}{3}$ of $\frac{3}{4}$ equals:
  $2 \times \frac{1}{4} = \frac{2}{4} = \frac{1}{2}$

Do Exs. 8–12 in the way that you like best:

	a	b	c
8.	$\frac{2}{3}$ of $\frac{6}{9}$	$\frac{2}{3}$ of $\frac{12}{15}$	$\frac{3}{4}$ of $\frac{8}{9}$
9.	$\frac{3}{5}$ of $\frac{5}{8}$	$\frac{4}{5}$ of $\frac{20}{21}$	$\frac{5}{8}$ of 16
10.	$\frac{3}{4}$ of $\frac{4}{5}$	$\frac{2}{3}$ of 6	$\frac{5}{6}$ of 18
11.	$\frac{5}{6}$ of 12	$\frac{5}{8}$ of $\frac{8}{9}$	$\frac{3}{5}$ of 10
12.	$\frac{3}{5}$ of $\frac{10}{11}$	$\frac{5}{8}$ of 24	$\frac{3}{5}$ of 15

13. Jim's grandfather sent him $\frac{3}{4}$ lb. of seed from his prize-winning corn. Jim wants to use $\frac{1}{3}$ of the seed corn for his first planting.

What part of a pound should he weigh out for the first planting?

14. Jim (Ex. 13) plans to save the rest of the seed corn for a later planting. What part of a pound of seed corn will he save?

15. How much is $\frac{2}{3}$ of $\frac{6}{10}$?

16. Leonard has a pedometer. It measures how far he walks.

When Leonard walks from his home to the movies and back, the pedometer shows he walks $\frac{8}{10}$ mi. How far is it from his home to the movies?

A mixed number times a whole number

1. Ellen wondered how much she would have to pay for $2\frac{5}{8}$ yd. of chintz at 24 cents a yard.

She thought, "The $\frac{5}{8}$ yd. would cost $\frac{5}{8}$ of 24¢, or _?_¢.

"The 2 whole yards would cost 2×24¢, or _?_¢.

"The total cost of the $2\frac{5}{8}$ yd. would be 15¢ + 48¢, or _?_¢."

2. The solution of Ellen's problem (Ex. 1) is usually written this way:→

$$\boxed{\begin{array}{rl} 24 & \\ \times\, 2\frac{5}{8} & \\ \hline 15 & \\ 48 & \text{Ans.} \\ \hline 63 & 63¢ \end{array}}$$

Where does the 15 come from? the 48? the 63?

3. Make a rule for finding a mixed number × a whole number.

Copy these examples without the work. Multiply. Then look to see if you have done them correctly.

	a	*b*	*c*
4.	$\begin{array}{r} 27 \\ \times\, 2\frac{2}{3} \\ \hline 18 \\ 54 \\ \hline 72 \end{array}$	$\begin{array}{r} 24 \\ \times\, 3\frac{3}{4} \\ \hline 18 \\ 72 \\ \hline 90 \end{array}$	$\begin{array}{r} 40 \\ \times\, 1\frac{5}{8} \\ \hline 25 \\ 40 \\ \hline 65 \end{array}$
5.	$\begin{array}{r} 40 \\ \times\, 5\frac{3}{5} \\ \hline 24 \\ 200 \\ \hline 224 \end{array}$	$\begin{array}{r} 72 \\ \times\, 4\frac{3}{8} \\ \hline 27 \\ 288 \\ \hline 315 \end{array}$	$\begin{array}{r} 84 \\ \times\, 2\frac{1}{2} \\ \hline 42 \\ 168 \\ \hline 210 \end{array}$

Some persons prefer to multiply a whole number and a mixed number the way it is done in these examples:

- $2\frac{3}{4} \times 3 = \frac{11}{4} \times \frac{3}{1} = \frac{33}{4} = 8\frac{1}{4}$
- $5 \times 1\frac{1}{2} = \frac{5}{1} \times \frac{3}{2} = \frac{15}{2} = 7\frac{1}{2}$

The mixed number is changed to a fraction; the whole number is made into a fraction by writing it over 1. Then the two fractions are multiplied in the usual way.

Do the multiplications in Exs. 6–10. Use the method you prefer.

	a	*b*	*c*
6.	$4\frac{1}{2} \times 18$	$14 \times 3\frac{2}{3}$	$5\frac{1}{6} \times 20$
7.	$18 \times 5\frac{2}{3}$	$5\frac{1}{4} \times 13$	$7 \times 3\frac{5}{8}$
8.	$6\frac{2}{9} \times 18$	$16 \times 2\frac{1}{2}$	$5\frac{3}{8} \times 20$
9.	$20 \times 6\frac{2}{5}$	$8\frac{1}{4} \times 6$	$8\frac{3}{8} \times 17$
10.	$7 \times 16\frac{2}{3}$	$21 \times 2\frac{3}{4}$	$3\frac{7}{8} \times 36$

11. Show that $4 \times 3\frac{1}{2} = 3\frac{1}{2} \times 4$.

12. Show that $3 \times 2\frac{1}{2} = 2\frac{1}{2} \times 3$.

13. Find the cost of $2\frac{3}{4}$ yd. of gingham at 48¢ a yard.

14. Find the cost of $3\frac{7}{8}$ lb. of cheese at 64¢ a pound.

15. Find the cost of $2\frac{3}{4}$ lb. of bird seed at 24¢ a pound.

Multiplying money by mixed numbers

1. Mary bought $\frac{3}{4}$ yd. of canvas for a duffel bag. The canvas cost \$1.95 a yard. How much did she spend?

Mary *estimated* the cost of the canvas this way:

▶ $\frac{1}{4}$ yd. will cost about 50¢.
▶ So $\frac{3}{4}$ yd. will cost about _?_.

Then Mary *figured* the cost this way:

$$\frac{3}{4} \times \$1.95 = \frac{\$5.85}{4} = \$1.46\tfrac{1}{4}$$

The saleslady figured the cost this way:

\$1.95	
× 3	
4)\$5.85	**Ans.**
\$1.46$\frac{1}{4}$	\$1.47

Is her way better than Mary's? Why did she charge \$1.47?

2. Jane bought $2\frac{3}{4}$ yd. of canvas for a camp cot. The canvas cost \$1.95 a yard. How much did she spend?

Jane estimated the cost of the canvas this way:

▶ \$1.95 is about \$2.00.
▶ 2 yd. will cost about _?_.
▶ $\frac{3}{4}$ yd. will cost about _?_.
▶ So $2\frac{3}{4}$ yd. will cost me about \$4.00 + \$1.50, or _?_.

To find the cost of $2\frac{3}{4}$ yd. of canvas, the saleslady figured this way:

\$1.95	
× $2\frac{3}{4}$	
4)\$5.85	
1.46$\frac{1}{4}$	
3.90	**Ans.**
\$5.36$\frac{1}{4}$	\$5.37

How did she get the \$5.85? the \$1.46$\frac{1}{4}$? the \$3.90? the \$5.36$\frac{1}{4}$? Why did she charge \$5.37?

Find the cost of the following. First estimate each answer.

3. $1\frac{1}{2}$ yd. of canvas at \$4.00 a yard; $3\frac{1}{4}$ yd.; $2\frac{3}{4}$ yd.

4. $2\frac{1}{4}$ yd. of padding at \$3.00 a yard; $4\frac{1}{8}$ yd.; $3\frac{7}{8}$ yd.

5. $2\frac{3}{4}$ yd. of leather at \$5.25 a yard; $5\frac{1}{8}$ yd.; $3\frac{5}{8}$ yd.

6. $3\frac{1}{8}$ yd. of velvet at \$4.50 a yard; $4\frac{5}{8}$ yd.; $5\frac{7}{8}$ yd.

Multiply. Check by estimating.

	a	*b*	*c*
7.	\$3.59 $3\frac{2}{3}$	\$6.89 $5\frac{2}{3}$	\$4.03 $3\frac{5}{6}$
8.	\$2.83 $4\frac{3}{8}$	\$3.39 $2\frac{3}{4}$	\$5.76 $4\frac{3}{5}$

Practice with fractions

▶ PRACTICE SET I

	a	b	c	d	e
1.	$\frac{3}{4} = \frac{?}{8}$	$\frac{2}{3} \times \frac{5}{6}$	$\frac{3}{8} + \frac{3}{4}$	$6\frac{4}{5} - 2\frac{2}{5}$	$6 \times 1\frac{3}{4}$
2.	$\frac{5}{6} = \frac{?}{12}$	$\frac{3}{8} \times \frac{3}{4}$	$2\frac{4}{5} + 3\frac{1}{4}$	$8\frac{1}{6} - 3\frac{2}{3}$	$\frac{5}{8} \times \frac{1}{3}$
3.	$\frac{28}{8} = ?$	$\frac{3}{4} \times \frac{5}{11}$	$5 \times 3\frac{1}{3}$	$12\frac{3}{4} - 5\frac{2}{3}$	$9 - 2\frac{7}{8}$

▶ PRACTICE SET II

	a	b	c	d	e
1.	$\begin{array}{r} \frac{4}{5} \\ +\frac{2}{3} \\ \hline \end{array}$	$\begin{array}{r} 5\frac{3}{5} \\ +6\frac{3}{4} \\ \hline \end{array}$	$\begin{array}{r} \frac{7}{8} \\ +\frac{3}{4} \\ \hline \end{array}$	$\begin{array}{r} 4\frac{3}{8} \\ +\frac{1}{2} \\ \hline \end{array}$	$\begin{array}{r} 5\frac{2}{3} \\ +6\frac{3}{8} \\ \hline \end{array}$
2.	$\begin{array}{r} 9 \\ -\frac{7}{8} \\ \hline \end{array}$	$\begin{array}{r} 6 \\ -2\frac{5}{6} \\ \hline \end{array}$	$\begin{array}{r} \frac{3}{4} \\ -\frac{2}{3} \\ \hline \end{array}$	$\begin{array}{r} 3\frac{5}{8} \\ -1\frac{1}{4} \\ \hline \end{array}$	$\begin{array}{r} 7\frac{2}{3} \\ -1\frac{4}{5} \\ \hline \end{array}$
3.	$\begin{array}{r} 24 \\ \times 2\frac{3}{8} \\ \hline \end{array}$	$\begin{array}{r} 35 \\ \times 3\frac{2}{5} \\ \hline \end{array}$	$\begin{array}{r} 16\frac{1}{2} \\ \times 7 \\ \hline \end{array}$	$\begin{array}{r} \$4.00 \\ \times 2\frac{3}{4} \\ \hline \end{array}$	$\begin{array}{r} 300 \\ \times 16\frac{2}{5} \\ \hline \end{array}$

▶ PRACTICE SET III

	a	b	c	d	e
1.	$\frac{2}{5} \times \frac{5}{6}$	$8 \times \frac{4}{5}$	$3 \times 6\frac{3}{4}$	$\frac{1}{2} - \frac{2}{5}$	$\frac{1}{2} + \frac{4}{5}$
2.	$6 - 2\frac{7}{8}$	$6 + 4\frac{5}{8}$	$\frac{3}{8} \times 4$	$\frac{5}{8} \times 4$	$4 \times \frac{4}{5}$

▶ PRACTICE SET IV

1. Find the product of 4 and $2\frac{1}{3}$.

2. Find the sum of $4\frac{1}{2}$ and $5\frac{2}{3}$.

3. Find the difference between $3\frac{2}{3}$ and $3\frac{3}{4}$.

4. If you take $8\frac{3}{4}$ lb. of corn out of a bag containing 50 lb., how much corn will be left in the bag?

5. In a group of 8 children, 5 are boys. Write a fraction to compare:
   - the number of boys with the whole group of children.
   - the number of girls with the whole group of children.
   - the number of boys with the number of girls.

Arithmetic roundup

▶ Oral review

1. Reduce to lowest terms:

$\frac{6}{9}$ $\frac{8}{12}$ $\frac{14}{16}$ $\frac{10}{16}$ $\frac{10}{20}$

2. Change to mixed numbers:

$\frac{11}{3}$ $\frac{13}{4}$ $\frac{19}{5}$ $\frac{26}{5}$ $\frac{31}{4}$

3. Change to twelfths:

$\frac{1}{6}$ $\frac{5}{6}$ $\frac{3}{4}$ $\frac{1}{3}$ $\frac{2}{3}$

4. Subtract from 5:

$\frac{2}{3}$ $\frac{3}{4}$ $\frac{1}{6}$ $\frac{7}{8}$ $\frac{3}{10}$

5. Multiply each fraction in Ex. 4 by 7.

6. Find $\frac{3}{4}$ of:

24 36 28 20 40

7. Round off to the nearest thousand: 5,027; 16,748; 206,824.

8. Dotty bought a cake for 45¢ and rolls for 28¢. How much change did she receive from 75¢?

9. Carl caught a $2\frac{1}{2}$-pound fish and a $1\frac{1}{4}$-pound fish. How many pounds of fish did he catch in all?

10. Is $24{,}286 \div 19$ more than 1,000? more than 2,000?

11. Does $8{,}024 \div 4 = 2{,}006$?

12. What is the average of 8, 10, 6, 5, and 11?

▶ Written review

1. Add $4{,}682 + 397 + 8{,}050 + 688$.
2. Add $\$26.85 + \$8.75 + \$57.69$.
3. From 8,000 take 275.
4. Take \$28.75 from \$75.
5. Find $600 \times \$18.98$.
6. Divide 23,313 by 409.
7. Multiply \$4.80 by $2\frac{3}{8}$.
8. Show that $2\frac{3}{4} \times 16 = 16 \times 2\frac{3}{4}$.
9. Do the multiplication in the box, using cancellation. Then do it without canceling. Are the two answers the same?

$\boxed{\frac{3}{4} \times \frac{5}{6}}$

10. Alice had $\frac{1}{2}$ pie. She cut it into 3 equal pieces and gave a piece to her father. What part of the whole pie did he get? What part did Alice have left?
11. Take the tests on pages 305–308.

Finding distance and time

1. The fastest speed at which an automobile has ever been driven is 403 miles an hour. At that rate, how far can the car travel in 2 hours? in 3 hours?

2. What is the automobile speed limit where you live? At that rate, how far can a car go in 2 hours? in 3 hours? in 4?

3. If you know *how many miles an hour* a car is going, and *how many hours* it travels, how can you find *how far* it travels?

4. Explain and illustrate the following rule:

Distance = *Time* × *Rate*

5. Walking at the rate of 4 miles an hour, how far can you go in 2 hours?

6. If you ride a bicycle at the rate of 8 miles an hour, how far can you ride in $2\frac{1}{2}$ hr.? in $3\frac{3}{4}$ hr.?

7. An airplane that travels 150 miles an hour can travel _?_ miles in $4\frac{1}{2}$ hours.

8. Are these statements true?

- How far you go depends on *how long* you travel.
- How far you go depends on *how fast* you travel.

9. Jane's father is driving to Chicago. Jane asked, "How long will the trip take?"

Her father said, "Chicago is 280 miles away. I usually drive about 40 miles an hour. You figure out how long the trip will take."

Jane thought, "You can find how many hours it will take to go 280 miles at 40 miles an hour by finding how many 40-mile stretches there are in 280 miles."

How do you find how many 40's there are in 280?

10. Draw a picture to help explain Ex. 9.

11. Explain and illustrate the following rule:

Time = *Distance* ÷ *Rate*

12. How long will it take a boat traveling 30 miles an hour to go 120 miles? 150 miles? 165 miles? 210 miles?

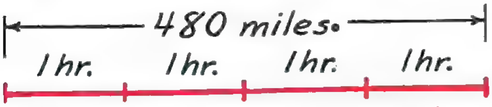
13. If Mr. King drives at the rate of 35 miles an hour, how long will it take him to drive 140 miles?

14. A Scout troop left Linton at 9:00 A.M., hiking at the rate of 4 miles an hour. At what time will the troop reach Newberry, which is 8 miles away?

Finding rate

1. A pilot flew 480 mi. in 4 hr. What was his rate of travel?

To solve this problem, Ben drew the diagram below. Explain it.



If the pilot travels 480 mi. in 4 hr., would he fly $\frac{1}{4}$ as far in 1 hr., on the average? What is $\frac{1}{4}$ of 480 mi.? $480 \div 4 =$ _?_.

2. Explain and illustrate the following rule:

Rate = Distance ÷ Time

3. What is the rate of travel if a bus goes 200 miles in 4 hours? 200 miles in 5 hours?

4. What is the rate of travel if a beetle travels 15 feet in 5 min.? 15 feet in 3 min.?

Time-rate-distance problems

1. Traveling at the rate of 80 mi. an hour, how far will a train travel in 3 hr.? 5 hr.? 8 hr.?

2. How long will it take a freight train traveling at 30 mi. an hour to go 900 mi.?

3. What is the rate of travel of a transport plane that flies 840 mi. in 7 hr.?

4. If you know how fast a train travels, and how long it travels, how can you find how far it travels?

5. If you know how far a plane flies, and how long the flight takes, how can you find the rate of travel of the plane?

6. If you know how far you want to go and at what rate you can travel, how can you find how long the trip will take?

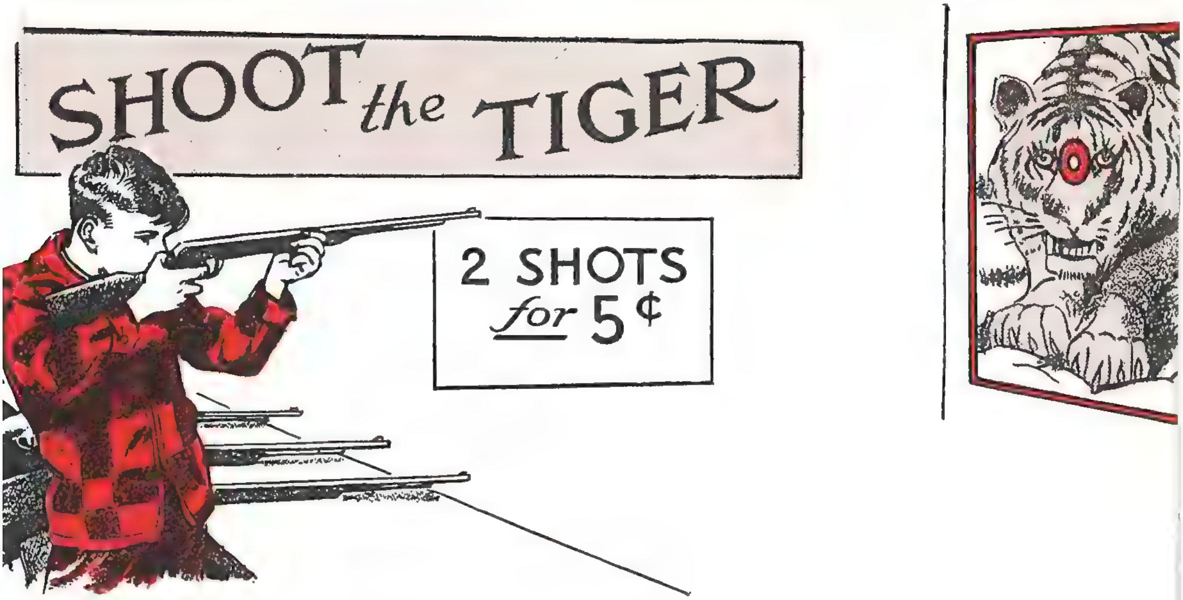
7. Explain how you can use the following rule if you want to find distance; to find time; to find rate:

Distance = Time × Rate

8. Make up a problem in finding distance when you know the rate and time.

Make up a problem in finding time when you know the distance and rate.

Make up a problem in finding rate when you know the distance and time.



Problems in grouping

1. Tom is at the State Fair. Look at the picture.

How much will Tom have to pay for 4 shots at the tiger? 6 shots? 8 shots? 12 shots?

2. How many shots at the tiger can Bill get for a quarter? Does this diagram answer the question?

Draw pictures for Exs. 3–8.

3. Tickets for rides on the Bucking Bronco sell at 3 for 10¢. A dozen tickets will cost _?_¢.

4. If candied apples sell at 2 for 25¢, how much will 8 cost? 12?

5. How many popcorn balls at 3 for 10¢ can you get for 20¢?

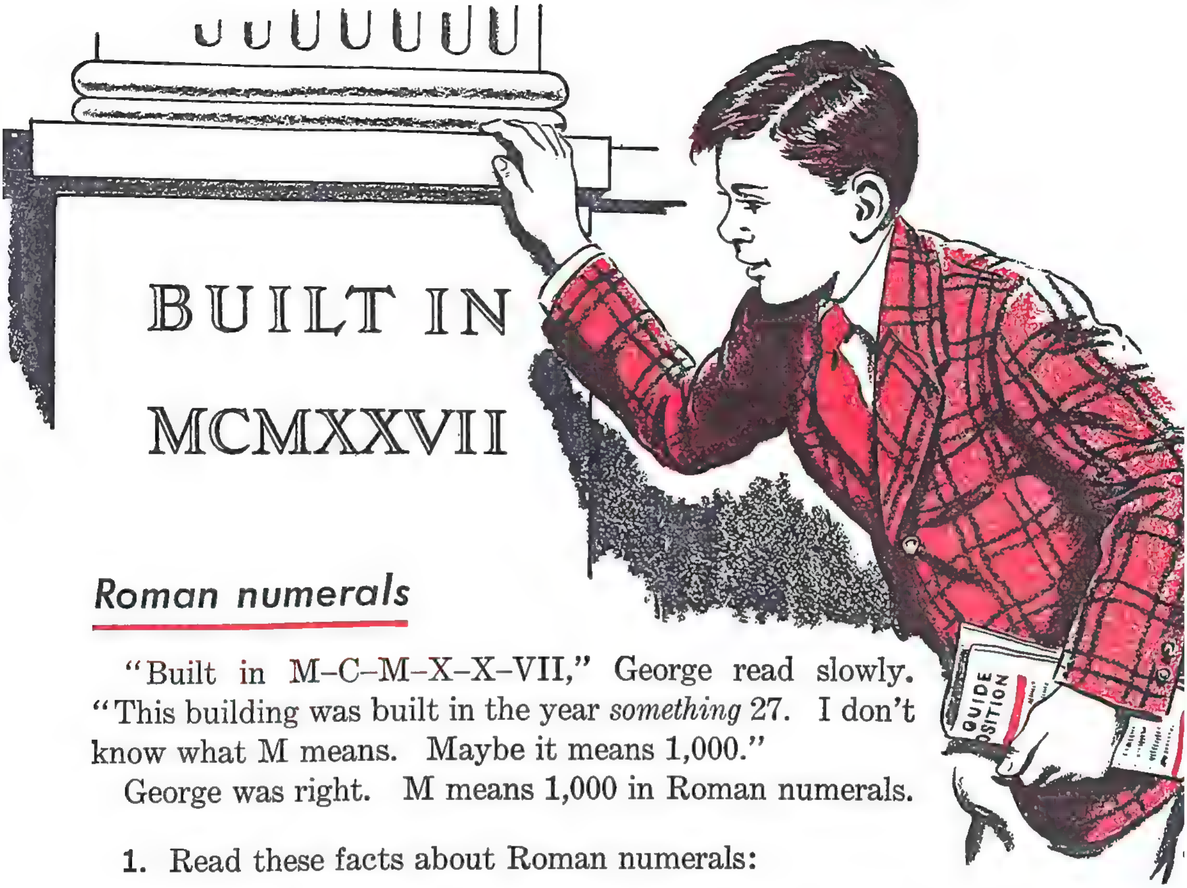
6. A man at the fair makes black paper cutouts at the rate of 4 in 10 minutes. At that rate, how many cutouts can he make in $\frac{1}{2}$ hr.? in $\frac{1}{4}$ hr.? in 1 hr.? in 50 minutes? in 5 minutes?

7. At one booth a man makes name pins like this one. They sell at 3 for $1.00.

How many pins will he have to sell at the rate of 3 for $1.00 to take in $5.00?

8. The weight guesser at the fair guessed the wrong weight for Joanne; so she was weighed free.

If he guesses the wrong weight of 3 out of every 10 persons, how many persons out of 100 are weighed free?



Roman numerals

"Built in M–C–M–X–X–VII," George read slowly. "This building was built in the year *something* 27. I don't know what M means. Maybe it means 1,000."

George was right. M means 1,000 in Roman numerals.

1. Read these facts about Roman numerals:

I = 1 V = 5 X = 10 L = 50 C = 100 D = 500 M = 1000

VI = 5 + 1 = 6	LX = 50 + 10 = 60	DC = 500 + 100 = 600
IV = 5 − 1 = 4	XL = 50 − 10 = 40	CD = 500 − 100 = 400
XI = 10 + 1 = 11	CX = 100 + 10 = 110	MC = 1000 + 100 = 1100
IX = 10 − 1 = 9	XC = 100 − 10 = 90	CM = 1000 − 100 = 900

2. Read these Roman numbers:

VIII	XVI	LXXI
CXXII	DCXXX	MCCXIII

3. Read these:

XIV	XIX	XLIV
XCIX	CDXC	CMXXIV

4. Write the Roman numerals from 1 to 20.

5. Count by 10's from 10 to 100. Write the Roman numerals for those numbers.

6. Count by 10's from 45 to 135. Write those numbers in Roman numerals.

7. Does XXIX + XXI = L?

8. Does C − XL = LX?

9. Below are the Roman numbers from 100 to 1,000 by 100's. Read the numbers and explain how each is formed.

C	CC	CCC	CD	D
DC	DCC	DCCC	CM	M

10. Read these numbers:

CCIX	MMXL	DXXXIX
DCCLI	CMXC	CCCXXVII

11. Write in Roman numerals:

411	312	425	542	1,214
772	867	979	635	1,380
645	732	549	153	1,490

12. Below are the Roman numbers from 900 to 2,000 by 100's. Explain how each is formed.

CM	M	MC	MCC
MCCC	MCD	MD	MDC
MDCC	MDCCC	MCM	MM

13. Can you read these?

MCL	MCCL	MDXL	MCMX
MDL	MCMV	MCCX	MCLX

14. Can you read the Roman number George saw on the building in the picture on page 102?

If you have difficulty, break up the number into parts like this: M–CM–XX–VII. Then you can easily see the 1,000, the 900, the 20, and the 7.

15. The year a building is erected is often shown on the building in Roman numerals.

Look about your community for illustrations of this. Copy the numerals and bring the copy to school for the class to read.

16. Read these famous dates and explain how they are formed. Do you know what each date is famous for?

MCMXLI	MDCCLXXVI
MCDXCII	MDCCLXXXIX
MDCVII	MDCCCLXV

17. How would you write 1948 in Roman numerals? How would you write 1951?

18. What year is it now? Write it in Roman numerals.

19. When you go to the movies, watch for the Roman numerals that tell you the year the picture was made.

20. Can you find the sum of 125 and 142, using Roman numerals?

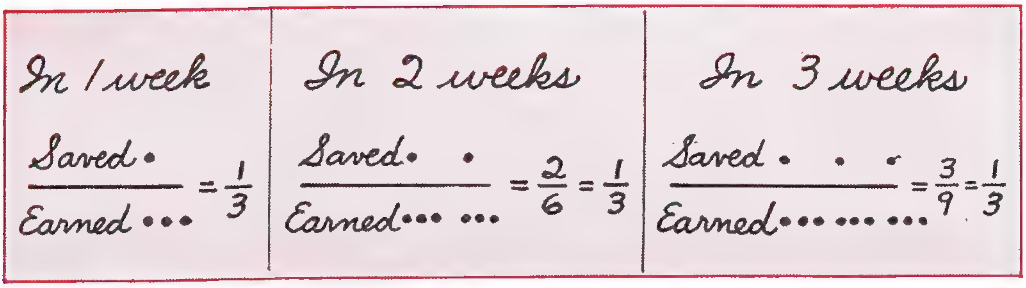
21. Have you ever read *The Wonderful Wonders of One-Two-Three* by David Eugene Smith?

This book contains many interesting facts about the systems different peoples have invented for writing numbers.

UNIT 16

Important social needs for finding what part one number is of another

Using fractions in comparisons



1. Beth earned \$3 baby-sitting last week. She saved \$1. What part of her earnings did she save?

$$\frac{\text{Compare}}{\text{Compare with}} \left\{ \begin{array}{l} \text{Savings} \longrightarrow \$1 \\ \text{Earnings} \longrightarrow \$3 \end{array} \right. = \frac{1}{3}$$

Beth saved $\frac{1}{3}$ of her earnings.

2. Suppose that Beth continues to earn and save the same amounts each week.

Will she still be saving one out of three dollars? Study the diagram above.

3. The diagram shows that 2 out of 6 is the same as _?_ out of 3.

4. The diagram shows that 3 out of 9 is the same as 1 out of _?_.

5. If Beth worked one more week, what fraction would compare her savings with her earnings? Would she still be saving one dollar out of every three?

6. Two out of five is the same as _?_ out of ten. $\frac{2}{5} = \frac{?}{10}$

7. 1 out of 4 is the same as 3 out of _?_. $\frac{1}{4} = \frac{3}{?}$

8. Don earned \$6 and saved \$4; Fred earned \$12 and saved \$8. Which boy saved the greater part of his earnings?

9. Dennis has finished 15 examples in an exercise containing 18. Jerry has finished 9 examples in an exercise containing 12.

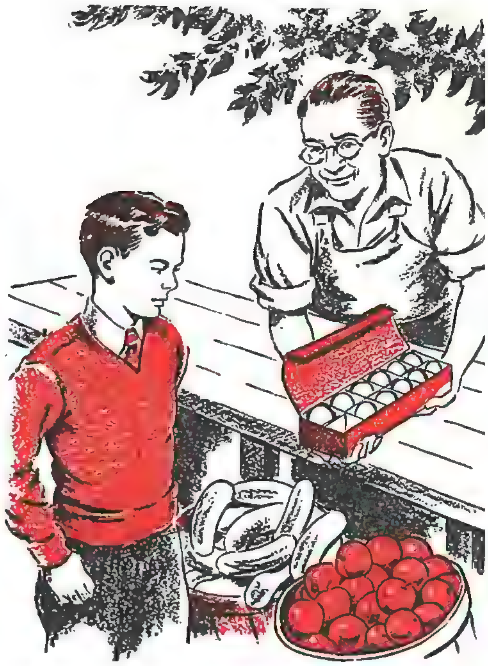
Who is $\frac{3}{4}$ finished? Who is $\frac{5}{6}$ finished?

Who has completed the larger part of his exercise? (Hint: To find which is larger, $\frac{3}{4}$ or $\frac{5}{6}$, change them to fractions having a common denominator.)

10. Nancy had 15 tickets to sell. She sold 12. Lucy had 12 to sell. She sold 10. Which girl sold the greater part of her tickets?

11. Which is the better spelling paper: one having 17 words correct out of 20, or one having 37 words correct out of 40?

Fractional parts



At a roadside stand Fred saw a sign: "Eggs, 60¢ a dozen."

When he asked for a dozen eggs, the farmer showed him this box and said, "I have only a part of a dozen."

Fred thought, "The box is divided into 12 equal parts. I am buying 11 parts, or $\frac{11}{12}$ of a dozen. $\frac{11}{12}$ of a dozen will cost $\frac{11}{12}$ of 60¢, or 55¢."

To find what part of a dozen eggs he was buying, Fred compared *the number of eggs in the box* with *the number of eggs in a dozen.*

1. Write a fraction to compare:

- 1 egg with a dozen eggs
- 6 eggs with a dozen eggs
- 8 eggs with a dozen eggs

2. What part of a dozen eggs is 1 egg? 2 eggs? 6 eggs? 8 eggs?

3. How many ounces are there in a pound? What part of a pound is 1 ounce?

$$\frac{\text{Compare}}{\text{Compare with}}\left\{\frac{1\text{ ounce}}{16\text{ ounces}} = \frac{1}{16}\right.$$

4. Write a fraction to compare 2 ounces with the number of ounces in a pound.

Your comparison shows that 2 ounces is what part of a pound?

5. What part of a pound is 3 oz.? 4 oz.? 6 oz.? 8 oz.? 10 oz.? 12 oz.? 14 oz.? 15 oz.?

6. How many inches are there in a foot? Write a fraction to compare 1 inch with the number of inches in a foot.

7. Write a fraction to compare 2 inches with the number of inches in a foot. Your comparison shows that 2 inches is what part of a foot?

8. What part of a foot is 3 in.? 4 in.? 6 in.? 8 in.? 10 in.?

9. What part of a yard is 3 in.? 6 in.? 8 in.? 9 in.? 12 in.? 18? 24? 27? 32?

10. What part of a year is 1 month? 3 months? 6 months? 9 months? 11 months?

11. What part of 30 chicks are 20 chicks? 15? 10? 5?

What part one number is of another

Owen looked at the sign in the picture below. "I think I'll go riding today," he said. "I have a quarter to spend."

How long can Owen ride for 25¢? To find the answer, think this way:

▶ For $1.00 he can hire the horse for 1 hour.

▶ Compare 25¢ with 100¢. You find that 25¢ = $\frac{25}{100}$, or $\frac{1}{4}$ of a dollar.

▶ For 25¢ he can hire the horse for $\frac{1}{4}$ of 1 hour, or 15 minutes.

1. What part of a dollar is 50¢? 75¢? 10¢? 20¢? 40¢? 60¢? 80¢?

2. At the rate of $1.00 for 8 hours, how long could you rent a boat for 50¢? 75¢? 25¢? 40¢? 60¢? 80¢?

3. At 10¢ a dozen, how many fishing worms can you get for 5¢?

(5¢ is what part of 10¢? Then what part of a dozen worms can you get? $\frac{1}{2}$ of 12 = _?_.)

4. Frogs are sold for bait at 30¢ a dozen. How many frogs can you get for 5¢? 10¢? 20¢?

5. At $1.20 a dozen, how many bottles of soda can Peter buy with 40¢? 80¢? $1.00?

6. At 40¢ a pound, how many ounces of candy can Wendy buy for 20¢? 10¢? 5¢? 30¢? 15¢? 25¢?

7. How many ounces of cheese at 64¢ a pound can you buy for 12¢? 20¢? 8¢? 24¢?

Earning money

1. How many minutes are there in an hour? What part of an hour is 1 minute?

2. Write a fraction to compare 30 minutes with the number of minutes in an hour.

Your comparison shows that 30 minutes is what part of an hour?

3. Write a fraction to compare 45 minutes with the number of minutes in an hour.

4. What part of an hour is 5 min.? 10 min.? 15 min.? 20 min.? 25? 30? 40? 45? 50 min.?

5. "I earn 60¢ an hour," said Paul. "Last Saturday I worked 6 hours and 20 minutes.

- "For 6 hours, at 60¢ an hour, I received _?_.
- "20 minutes is $\frac{20}{60}$ of an hour, or _?_ hour. $\frac{1}{3}$ of an hour's pay is $\frac{1}{3}$ of 60¢, or _?_.
- "So I received \$3.60 for the 6 hours, plus \$.20 for the 20 minutes, or _?_ all together."

6. One day Paul worked 4 hours and 30 minutes, at 60¢ an hour.

For the 4 hours he received _?_; for the 30 minutes he received $\frac{30}{60}$ of an hour's pay, or $\frac{1}{?}$ of 60¢.

He received _?_ for his work.

7. Find what Paul should receive (at 60¢ an hour) if he works:

5 hr. 15 min.	4 hr. 45 min.
6 hr. 40 min.	5 hr. 10 min.
6 hr. 50 min.	7 hr. 20 min.

8. Noel's uncle pays him 50¢ an hour to work in his store. He works 7 hr. 30 min. on Saturdays, and earns _?_.

9. Gil works for a fruit dealer. During one week he worked 55 min. on Monday, 50 min. on Tuesday, 55 min. on Wednesday, 50 min. on Thursday, and 45 min. on Friday.

That was _?_ min. all together, or _?_ hr. and _?_ min.

At 40¢ an hour, how much money should Gil have received for his 4 hr. and 15 min. of work?

10. At 90¢ an hour, how much will a man earn in 4 hr. and 40 min.?

11. A riding stable charges \$1.80 an hour for a horse. How much should Donald pay if he rides for 20 min.? 30 min.? 40 min.? 50 min.?

12. At \$.60 an hour, how much will Ned earn by working 5 hr. and 10 min.?

Everyday problems

1. Patsy's recipe for muffins makes enough for 6 persons. (See picture.)

How much of each ingredient should she use for only 4 persons?

2. At a rate of 60 miles an hour, how far will a train go in $3\frac{1}{2}$ hr.?

3. If baked beans are selling at 3 cans for 29¢, how much will a dozen cans cost?

4. Which is the better record: 12 hits out of 16 times at bat, or 10 hits out of 12 times at bat?

5. Find the cost of 27 inches of gingham that sells at 60¢ a yard.

6. When eggs sell at 64¢ a dozen, how much will 8 eggs cost?

7. How many comic books at 3 for 20¢ can you get for a dollar?

8. A plane travels at an average rate of 120 miles an hour. How long will it take the plane to go 280 miles?

9. How much will you earn in 3 hours and 40 minutes if you are earning 60¢ an hour?

10. Mrs. Crane gave Hazel 40¢ to buy $\frac{1}{2}$ lb. of cheese.

The clerk cut a piece of cheese, weighed it, and said, "This weighs 9 oz. Will that do?"

Hazel replied, "Yes, if I have enough money to pay for it."

The cheese cost 64¢ a pound. Hazel thought, "There are 16 ounces in a pound. 9 ounces are $\frac{9}{16}$ of a pound. $\frac{9}{16}$ of a pound will cost $\frac{9}{16}$ of 64¢, or __?__¢."

Did Hazel have enough to pay for 9 ounces of cheese? Remember that her mother gave her 40¢.

11. At 64¢ a pound for cheese, how much would Hazel have had to pay for
4 oz.? 5 oz.? 7 oz.? 10 oz.?

12. Patsy sells bran muffins at her roadside stand for 28¢ a dozen.
For 9 muffins she gets _?_¢.

13. Yesterday Ed worked at Patsy's stand 2 hr. and 10 min. Today, 1 hr. and 30 min.
How long did Ed work in all?

14. Patsy pays Ed 30¢ an hour. How much should she pay him for working 3 hr. 40 min.?

15. Patsy charges 45¢ for a dozen ears of corn. Ben buys 8 ears. What part of a dozen does he buy?
How much should he pay?

16. Pete needs 5 ft. 4 in. of wire netting for a rabbit pen. The price is 12¢ a foot.
How much will the wire cost?

17. 40 oz. of grain are needed each day to feed a flock of 50 chicks. How many ounces are needed to feed 30 chicks?

18. A camp charges $35 a week. How much would you have to pay if you stayed 1 day? 2 days? 3 days? 4 days? 5 days? 6 days? 2 weeks and 4 days?

19. If rayon sells at 60¢ a yard, how much will 30 inches of the rayon cost?

20. How many times can George ride around the lake for a quarter? (See picture.)

Multiplying fractions and mixed numbers

***Buy* KENTUCKY BLUE GRASS**

Sow 4½ lb. of seed to every 100 square yards of lawn space. Seed sold by package only: ½ lb. for 45¢; 1 lb. for 80¢; 2 lb. for \$1.50; 5 lb. for \$3.60; 10 lb. for \$7.00.

Lawn Supplies, Inc.
PARADISE, ILLINOIS

Frank wants to buy lawn seed to sow on the terrace of his home. He saw the above advertisement.

1. How many pounds of seed are needed for 100 square yards?

2. Frank found the area of his terrace to be 75 sq. yd.

Write a fraction to compare the number of square yards in Frank's terrace with 100 sq. yd. Reduce the fraction to lowest terms.

3. Frank says that for 100 sq. yd. he would need $4\frac{1}{2}$ lb. of seed; so for 75 sq. yd. he will need $\frac{3}{4}$ of $4\frac{1}{2}$ lb. Explain.

4. Can you find $\frac{3}{4}$ of $4\frac{1}{2}$? Try changing $4\frac{1}{2}$ to an improper fraction and multiplying like this:

$$\boxed{\frac{3}{4} \times 4\frac{1}{2} = \frac{3}{4} \times \frac{9}{2} = \frac{27}{8} = 3\frac{3}{8}}$$

Frank found he needs $3\frac{3}{8}$ lb. of grass seed. Do you agree?

5. Should Frank buy $3\frac{1}{2}$ lb. or 4 lb. of seed? Why?

6. Frank's seed will cost _?_.

7. How much seed is needed to sow 50 sq. yd. of lawn space?

8. To seed 50 sq. yd. of lawn, do you need to buy $2\frac{1}{2}$ lb. of seed or 3 lb. of seed? What will it cost?

9. Find the cost of seeding 80 sq. yd. of lawn space; 40 sq. yd.

Multiply:

	a	*b*	*c*
10.	$\frac{5}{6} \times 2\frac{2}{5}$	$\frac{1}{2} \times 3\frac{1}{3}$	$\frac{8}{9} \times 2\frac{1}{4}$
11.	$\frac{3}{4} \times 1\frac{1}{2}$	$\frac{2}{3} \times 2\frac{3}{4}$	$\frac{3}{8} \times 5\frac{1}{3}$
12.	$\frac{7}{8} \times 1\frac{3}{5}$	$\frac{2}{3} \times 2\frac{1}{4}$	$\frac{1}{4} \times 7\frac{1}{3}$

13. Make a rule for multiplying a mixed number by a fraction.

14. If you can find $\frac{3}{4} \times 1\frac{1}{2}$, can you also find $1\frac{1}{2} \times \frac{3}{4}$?

15. Make a rule for multiplying a fraction by a mixed number.

16. Find $\frac{3}{8} \times 2\frac{1}{2}$ and $2\frac{1}{2} \times \frac{3}{8}$.

17. Find $\frac{7}{8} \times 1\frac{3}{4}$ and $1\frac{3}{4} \times \frac{7}{8}$.

18. Would you estimate $\frac{7}{8} \times 3\frac{1}{2}$ to be a little more than $3\frac{1}{2}$ or a little less than $3\frac{1}{2}$? Why?

A mixed number times a mixed number

1. Martin wants to buy grass seed for 150 sq. yd. of lawn space.

Write a fraction to compare 150 sq. yd. with 100 sq. yd. Reduce the fraction to simplest form.

2. If Martin (Ex. 1) uses the same kind of grass seed as Frank (p. 110), he will need $1\frac{1}{2} \times 4\frac{1}{2}$ lb. of seed. Explain.

3. Can you find $1\frac{1}{2} \times 4\frac{1}{2}$? Try changing the mixed numbers to improper fractions and multiplying like this:

$$\boxed{1\tfrac{1}{2} \times 4\tfrac{1}{2} = \tfrac{3}{2} \times \tfrac{9}{2} = \tfrac{27}{4} = 6\tfrac{3}{4}}$$

Martin needs _?_ lb. of seed.

4. Using the information in the advertisement on page 110, which of the following would you advise Martin to buy?

- Seven 1-lb. packages
- A 5-lb. package and two 1-lb. packages
- A 5-lb. package and a 2-lb. package
- A 5-lb. package, a 1-lb. package, and a $\frac{1}{2}$-lb. package

5. How much will Martin's seed cost? (Ex. 4)

6. How much seed is needed to sow 250 sq. yd. of lawn?

7. From the advertisement on page 110, figure the cheapest way to buy $11\frac{1}{4}$ lb. of seed.

Find the cost of this amount of the seed.

8. How much seed is needed to sow 225 sq. yd. of lawn? Find the cost of the seed.

9. How much seed is needed to sow 175 sq. yd. of lawn? Find the cost of the seed.

10. Make up a rule for multiplying a mixed number by a mixed number.

11. A candy recipe calls for $2\frac{1}{2}$ cups of sugar. How much sugar should you use if you want $1\frac{1}{2}$ times as much candy as the recipe makes?

12. Bill is picking apples. The baskets he uses hold $1\frac{1}{4}$ bushels of apples each.

Bill has filled $2\frac{1}{2}$ baskets. How many bushels of apples has he picked?

Multiply:

	a	*b*	*c*
13.	$2\frac{1}{3} \times 1\frac{1}{2}$	$6\frac{2}{3} \times 1\frac{1}{2}$	$2\frac{1}{2} \times 4\frac{1}{2}$
14.	$4\frac{1}{2} \times 2\frac{1}{3}$	$4\frac{1}{2} \times 2\frac{1}{4}$	$4\frac{1}{5} \times 2\frac{1}{7}$
15.	$1\frac{3}{4} \times 3\frac{1}{2}$	$3\frac{1}{3} \times 2\frac{1}{2}$	$2\frac{1}{4} \times 1\frac{1}{3}$

Fraction problems

Jed and Albert need 20 large rubber bands for some model airplanes they are making. The bands sell at 8 for 5¢.

Here are the ways the boys figured out the cost of 20 bands:

① Jed said, "If 8 bands cost 5¢, one band will cost $\frac{1}{8}$ of 5¢, or $\frac{5}{8}$¢.

"20 bands will cost $20 \times \frac{5}{8}$¢.

"$20 \times \frac{5}{8}$¢ $= 12\frac{1}{2}$¢; so 20 bands will cost 13¢."

② Albert said, "20 bands are $2\frac{1}{2}$ times as many bands as 8 bands.

"So 20 bands will cost $2\frac{1}{2} \times 5$¢.

"$2\frac{1}{2} \times 5$¢ $= 12\frac{1}{2}$¢; so 20 bands will cost 13¢."

JED'S WAY

$$\frac{1}{8} \text{ of } 5 = 5 \div 8 = \frac{5}{8}$$

$$\frac{\overset{5}{\cancel{20}}}{1} \times \frac{5}{\underset{2}{\cancel{8}}} = \frac{25}{2} = 12\frac{1}{2}$$

(Ans. 13¢)

ALBERT'S WAY

$$20 \div 8 = 2\frac{1}{2}$$

$$2\frac{1}{2} \times 5 =$$

$$\frac{5}{2} \times \frac{5}{1} = \frac{25}{2} = 12\frac{1}{2}$$

(Ans. 13¢)

1. Find the cost of 18 plums at 8 for 5¢. Use the method you like best. Then look at the work below.

FIRST SOLUTION

$$\frac{1}{8} \text{ of } 5 = \frac{5}{8} \qquad \frac{\overset{9}{\cancel{18}}}{1} \times \frac{5}{\underset{4}{\cancel{8}}} = \frac{45}{4} = 11\frac{1}{4} \text{ (Ans. 12¢)}$$

SECOND SOLUTION

$$18 \div 8 = 2\frac{1}{4} \qquad 2\frac{1}{4} \times 5 = \frac{9}{4} \times \frac{5}{1} = \frac{45}{4} = 11\frac{1}{4} \text{ (Ans. 12¢)}$$

Find the cost of the following:

2. 16 bobby pins at 6 for 5¢
3. 12 plums at 8 for 15¢
4. 20 paper clips at 7 for 5¢
5. 20 nails at 12 for 10¢
6. 20 pretzel sticks at 8 for 5¢
7. 30 tacks at 8¢ a dozen
8. 30 paper spoons at 8 for 5¢
9. 30 paper forks at 6 for 5¢
10. 30 paper plates at 12 for 10¢
11. 30 paper cups at 7 for 5¢

1. How much should you pay for 5 of these pine cones?

Try to solve the problem before looking at the solutions in the box. Then explain the first solution; the second solution. Which do you like better?

FIRST SOLUTION

$15¢ \div 2 = 7\frac{1}{2}¢$ (cost of 1 cone)

$5 \times 7\frac{1}{2}¢ = \frac{5}{1} \times \frac{15}{2} = \frac{75}{2} = 37\frac{1}{2}¢$ (Ans. 38¢)

SECOND SOLUTION

5 cones = ? times 2 cones $\quad 5 \div 2 = 2\frac{1}{2}$

$2\frac{1}{2} \times 15¢ = \frac{5}{2} \times \frac{15}{1} = \frac{75}{2} = 37\frac{1}{2}¢$ (Ans. 38¢)

2. How much should Dick pay for 10 ears of corn at 4 for 15¢? Use the solution you prefer.

How much should you pay for:

3. 10 pencils at 3 for 10¢?
4. 10 screws at 4 for 5¢?
5. 15 erasers at 2 for 5¢?
6. 18 push pins at 8 for a dime?
7. 8 pencil clips at 3 for a nickel?
8. 18 bottle tops at 12 for 5¢?

9. Find the cost of 10 roller-coaster tickets at 3 for 25¢; of 10 Ferris wheel tickets at 4 for 25¢.

10. How long will it take Sue to iron 15 handkerchiefs if she can iron 4 in 5 min.?

11. What will 15 apples cost at 4 for 5¢? at 6 for 5¢?

12. How long will it take Carolyn to peel 25 potatoes if she can peel 10 in 9 min.?

The 4-H Club picnic

1. The boys and girls of the 4-H Club are to have a picnic at Shady Brook.

Tom is to make the pointed sticks for toasting marshmallows. He estimates he should make about 2 sticks for every 3 persons.

There will be 20 persons at the picnic. How many sticks should he make?

2. Bill is going to take corn to roast. He estimates that 33 ears of corn will be needed. How many dozen ears is that?

How much will the corn cost at 50¢ a dozen?

3. Sue wants to make $1\frac{1}{2}$ times this roll recipe. How much of each ingredient should she use?

ICEBOX ROLLS

$7\frac{1}{2}$ cups flour
$2\frac{3}{4}$ cups water
1 cup sugar, 2 eggs
$\frac{1}{2}$ teaspoon soda
1 tablespoon salt
1 cake compressed yeast
$\frac{1}{2}$ teaspoon baking powder
$\frac{1}{2}$ cup melted shortening

4. Find the cost of:

- 20 picnic plates at 8 for 10¢
- 20 paper cups at 6 for 10¢
- 20 paper forks at 4 for 5¢

5. Esther is making three times the amount of this brownie recipe. How much of each ingredient should she use?

BROWNIES

2 eggs
1 cup sugar
$\frac{3}{4}$ cup flour
$\frac{1}{2}$ cup butter
$\frac{2}{3}$ cup chopped nuts
2 squares chocolate

6. Betty Jane is bringing fruit punch. This recipe makes enough for 10 glasses. How much of each ingredient should she use for 45 glasses?

PICNIC PUNCH

$2\frac{1}{2}$ cups grape juice
$1\frac{1}{4}$ cups pineapple juice
$1\frac{3}{4}$ cups orange juice
$\frac{1}{4}$ cup lemon juice
4 cups water
$\frac{3}{4}$ cup sugar

7. There are about 6 hot dogs in a pound. Allowing 2 hot dogs for each of 20 persons, how many pounds of hot dogs should Ethel buy?

8. At 50¢ a pound, how much will the hot dogs cost?

9. Find the cost of 40 doughnuts at 30¢ a dozen.

Two-figure multipliers of mixed numbers

1. Miss Carter asked her class to find the cost of 25 cantaloupes at $12\frac{1}{2}$¢ each.

Here are John's and Judith's solutions. Did they both get the same answer? Can you explain both solutions?

In John's solution where does the 625 come from?

In Judith's solution, where does the partial product $12\frac{1}{2}$ come from? the 60? the 24?

JOHN

$$25 \times 12\tfrac{1}{2}¢ = \frac{25}{1} \times \frac{25}{2} = \frac{625}{2} = 312\tfrac{1}{2}¢$$

(Ans. $3.13)

JUDITH

$$\begin{array}{r} \$\ .1\ 2\frac{1}{2} \\ 2\ 5 \\ \hline 1\ 2\frac{1}{2} \\ 6\ 0 \\ 2\ 4 \\ \hline \$3.1\ 2\frac{1}{2} \end{array}$$

(Ans. $3.13)

2. Victor said, "I use John's way of multiplying when the numbers are small. I use Judith's way when the numbers are large."

Can you see any sense to doing as Victor does?

Try out his suggestion in multiplying $14\frac{3}{4}$ by 36. Is this multiplication easier to do by John's way or by Judith's?

3. There is one *mistake* in these multiplications. Can you find it?

$$\begin{array}{r} 16\frac{2}{3} \\ 12 \\ \hline 8 \\ 32 \\ 16 \\ \hline 200 \end{array} \qquad \begin{array}{r} 25\frac{3}{4} \\ 17 \\ \hline 12\frac{3}{4} \\ 175 \\ 25 \\ \hline 437\frac{3}{4} \end{array} \qquad \begin{array}{r} 38\frac{3}{8} \\ 22 \\ \hline 8\frac{1}{4} \\ 76 \\ 76 \\ \hline 834\frac{1}{4} \end{array}$$

4. Show that $24 \times 16\frac{2}{3}$ equals the same number as $16\frac{2}{3} \times 24$.

5. Show that $18\frac{3}{4} \times 25$ equals the same number as $25 \times 18\frac{3}{4}$.

Multiply:

	a	*b*	*c*
6.	$\begin{array}{r} 15\frac{3}{4} \\ \underline{48} \end{array}$	$\begin{array}{r} 18\frac{1}{2} \\ \underline{64} \end{array}$	$\begin{array}{r} 17\frac{1}{4} \\ \underline{36} \end{array}$
7.	$\begin{array}{r} 16\frac{5}{8} \\ \underline{18} \end{array}$	$\begin{array}{r} 42\frac{7}{8} \\ \underline{22} \end{array}$	$\begin{array}{r} 28\frac{1}{6} \\ \underline{16} \end{array}$
8.	$\begin{array}{r} \$.06\frac{1}{4} \\ \underline{28} \end{array}$	$\begin{array}{r} \$.14\frac{2}{7} \\ \underline{35} \end{array}$	$\begin{array}{r} \$.37\frac{1}{2} \\ \underline{56} \end{array}$

9. Mr. Pitt is sending a mail order for 11 gal. of house paint. The paint weighs $14\frac{1}{2}$ lb. per gallon. What is its total weight?

10. Andy's bicycle moves forward $19\frac{1}{2}$ ft. with one turn of the pedal. How many feet will he travel in 75 turns of the pedal?

Multiplying with fractions and mixed numbers

	EXAMPLE	CHANGE TO FRACTION FORM	MULTIPLY NUMERATORS AND DENOMINATORS	REDUCE	PAGE WHERE TAUGHT
A	$8 \times \frac{2}{3}$	$\frac{8}{1} \times \frac{2}{3}$	$= \frac{8 \times 2}{1 \times 3} = \frac{16}{3}$	$= 5\frac{1}{3}$	86, 91
B	$\frac{2}{3} \times \frac{2}{5}$		$= \frac{2 \times 2}{3 \times 5} = \frac{4}{15}$		90
C	$\frac{2}{3} \times 7$	$= \frac{2}{3} \times \frac{7}{1}$	$= \frac{2 \times 7}{3 \times 1} = \frac{14}{3}$	$= 4\frac{2}{3}$	91
D	$2\frac{1}{4} \times 5$	$= \frac{9}{4} \times \frac{5}{1}$	$= \frac{9 \times 5}{4 \times 1} = \frac{45}{4}$	$= 11\frac{1}{4}$	95
E	$5 \times 7\frac{1}{2}$	$= \frac{5}{1} \times \frac{15}{2}$	$= \frac{5 \times 15}{1 \times 2} = \frac{75}{2}$	$= 37\frac{1}{2}$	95, 115
F	$\frac{2}{3} \times 2\frac{2}{3}$	$= \frac{2}{3} \times \frac{8}{3}$	$= \frac{2 \times 8}{3 \times 3} = \frac{16}{9}$	$= 1\frac{7}{9}$	110
G	$2\frac{1}{3} \times \frac{2}{3}$	$= \frac{7}{3} \times \frac{2}{3}$	$= \frac{7 \times 2}{3 \times 3} = \frac{14}{9}$	$= 1\frac{5}{9}$	110
H	$1\frac{1}{3} \times 1\frac{1}{4}$	$= \frac{4}{3} \times \frac{5}{4}$	$= \frac{4 \times 5}{3 \times 4} = \frac{20}{12}$	$= 1\frac{8}{12} = 1\frac{2}{3}$	111

1. In the table are eight kinds of examples in multiplying with fractions and mixed numbers.

Explain how each example is done.

In Example B the 90 in the last column tells you that examples like B are taught on page 90, and so on.

2. Example A illustrates "a whole number times a fraction."

What does B illustrate? C? D? E? F? G? H?

3. When two fractions are multiplied (B), you multiply the numerators together and multiply the _?_ together.

Problems using measures

1. Charlotte needs 24 inches of velvet ribbon. How much will she pay for it at 27¢ a yard?

2. Do 28 months equal $2\frac{1}{4}$ yr., $2\frac{1}{3}$ yr., or $2\frac{1}{2}$ yr.?

3. One day Sue had 12 doz. eggs ready to sell. Sue said 12 doz. is a gross. How many eggs are there in a gross?

4. Bill has twin Jersey calves, Molly and Dolly. Last month he fed each calf 12 pk., or _?_ bu., of mixed feed. At $1.80 a bushel the feed for each calf cost _?_.

5. Last month each calf was fed 1 bu., or _?_ qt., of corn. Each ate a little more than _?_ qt. a day.

6. Together Molly and Dolly ate 50 lb. of hay last month. At this rate, they would eat _?_ lb. in 2 mo.

100 lb. is 1 *hundredweight* (*cwt.*)

7. How many pounds are there in 2 hundredweight? in $2\frac{1}{2}$ hundredweight? 3? 4? 5?

8. In 4 mo. the calves will eat 4×50 lb., or _?_ lb., of hay. Does 200 lb. equal $\frac{1}{2}$, $\frac{1}{5}$, or $\frac{1}{10}$ of a ton?

9. How many quart bottles can be filled from a 5-gal. can of milk? a 10-gal. can?

10. How many half-pint cartons can be filled from a quart jar of cream? from a 2-gal. can?

11. Look at the picture. When the school nurse put a bandage on Pete's finger this morning, she told him to keep it on for 24 hours. When may Pete take the bandage off?

Oral review of measures

Review the tables of measures on page 309. Then tell the missing numbers below.

	a	*b*	*c*
1.	1 ft. = _?_ in.	1 pk. = _?_ qt.	3 lb. 6 oz. = _?_ oz.
2.	1 yd. = _?_ ft.	1 lb. = _?_ oz.	2 tons = _?_ lb.
3.	1 yd. = _?_ in.	1 ton = _?_ lb.	2 hr. 15 min. = _?_ min.
4.	1 mi. = _?_ ft.	1 yr. = _?_ mo.	3 min. 20 sec. = _?_ sec.
5.	1 bu. = _?_ pk.	1 wk. = _?_ da.	6 doz. = _?_ things
6.	1 yr. = _?_ da.	1 da. = _?_ hr.	3 yd. 6 in. = _?_ in.
7.	1 qt. = _?_ pt.	1 hr. = _?_ min.	4 gal. = _?_ qt.
8.	1 gal. = _?_ qt.	1 min. = _?_ sec.	1 doz. = _?_ things
9.	1 pt. = _?_ cups	2 pt. = _?_ cups	4 bu. 2 pk. = _?_ pk.

10. Are there more inches or more feet in a given distance?

11. Are there more hours or more minutes in a given time?

12. To change a number of quarts into pints, do you multiply by 2 or divide by 2?

13. How do you change a number of pounds into ounces? a number of ounces into pounds?

14. Make a rule for changing small units of measure into larger units of measure. Give several illustrations of your rule.

15. Make a rule for changing large units of measure into smaller units of measure. Give several illustrations of your rule.

16. Name a fraction that compares 5 inches with a foot.

17. 7 inches is what part of a foot?

18. 3 inches is what part of a foot?

19. 2 quarts is what part of a gallon?

20. 8 ounces is what part of a pound?

21. 20 minutes is what part of an hour?

22. 9 things is what part of a dozen?

Find the cost of:

23. 9 eggs at 40¢ a dozen.

24. 4 oz. of butter at 60¢ a pound.

25. 3 pk. of tomatoes at 60¢ a bushel.

26. 24 in. of lace at 15¢ a yard.

27. At 60¢ an hour, how much can you earn in 2 hr. and 40 min.?

28. Could you find the answer to Ex. 27 by thinking, "If you earn 1¢ a minute, how much will you earn in 160 min.?"

29. At 40¢ an hour, how much can you earn in 1 hr. 15 min.? in 1 hr. 45 min.?

30. In this division, was Bill changing ounces to pounds, or pounds to ounces?

$$\boxed{\frac{36 \text{ oz.}}{16 \text{ oz.}} = 2\tfrac{1}{4}}$$

31. At 66 cents a pound, how much will 36 oz. of hamburger cost?

32. In this division, Margaret was changing _?_ to _?_.

$$\boxed{\frac{78 \text{ in.}}{12 \text{ in.}} = 6\tfrac{1}{2}}$$

33. Mary Jane did this multiplication to change _?_ to _?_.

$$\boxed{\begin{array}{r} 12 \text{ in.} \\ \times\ 4\frac{3}{4} \\ \hline 9 \\ 48 \\ \hline 57 \text{ in.} \end{array}}$$

34. What would you do to change 57 in. to feet?

35. To change 44 in. to feet, would you divide 44 in. by 12 in., or divide 12 in. by 44 in.?

36. To change 18 in. to yards, would you divide 36 in. by 18 in., or divide 18 in. by 36 in.?

37. To change 45 min. to hours, would you divide 60 min. by 45 min., or divide 45 min. by 60 min.?

38. To change 20 cups to pints, would you:

- divide 20 cups by 2 cups?
- find $\frac{1}{2}$ of 20 cups?
- divide 2 cups by 20 cups?

39. To change 4 yards to feet, would you:

- multiply 4 yards by 3?
- multiply 3 feet by 4?
- use 4 feet as an addend three times?

40. Make up a problem to fit each of these statements:

- 3×2 cups $= 6$ cups
- 2×3 cups $= 6$ cups.
- 6 cups $\div$ 2 cups $= 3$
- $\frac{1}{2}$ of 6 cups $= 3$ cups

Finding perimeter

Lester and Clarence are helping their father set up the cold drink stand at the Firemen's Carnival.

They are putting up colored electric lights around the top of the stand. The lights come strung on wire, as shown in the picture.

The stand is 6 ft. long and 4 ft. wide. Here is a plan of the stand showing that its shape is a rectangle.

1. How would you find how many feet of wiring they need to go around the stand?

This is the way Lester, Clarence, and their father found how many feet of wiring they need:

LESTER'S WAY

6 ft. + 4 ft. + 6 ft. + 4 ft. = 20 ft.

CLARENCE'S WAY

2 × 6 ft. = 12 ft.; 2 × 4 ft. = 8 ft.
12 ft. + 8 ft. = 20 ft.

THEIR FATHER'S WAY

6 ft. + 4 ft. = 10 ft.
2 × 10 ft. = 20 ft.

2. All three of them found they need _?_ ft. of wire. Whose method do you like best?

The distance around a rectangle is its *perimeter*.

3. How many feet of wiring were needed to string lights around the Merry-Go-Round ticket booth? The booth is $3\frac{1}{2}$ feet square.

In three different ways find the perimeters of these rectangles:

	a		b	
	WIDTH	LENGTH	WIDTH	LENGTH
4.	50 ft.	80 ft.	$48\frac{1}{2}$ ft.	125 ft.
5.	60 ft.	93 ft.	$67\frac{1}{2}$ ft.	130 ft.
6.	86 ft.	130 ft.	$83\frac{1}{4}$ ft.	$162\frac{1}{2}$ ft.

7. How many feet of rope will enclose a rectangle 82 ft. (82′) by 18 ft. (18′), to be used for pitching horseshoes?

8. How many inches of framing are needed to frame a picture 8 inches (8″) by 12 inches (12″)?

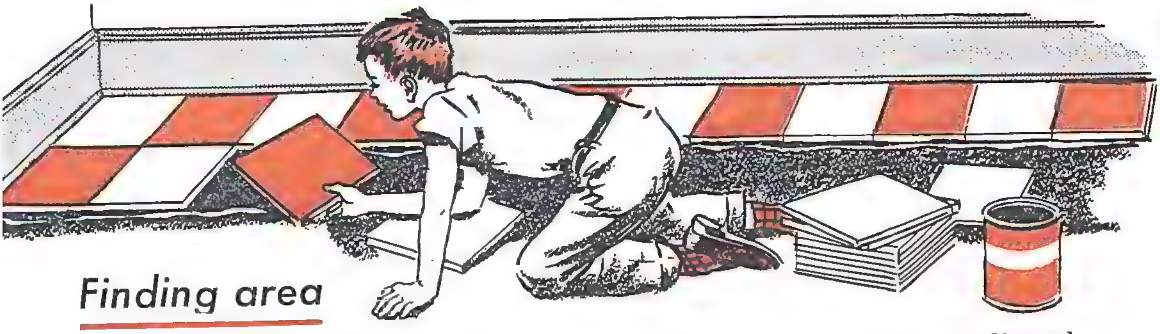
9. A lot for bronco-riding is 40 ft. wide and 30 yd. long. How many feet of fencing are used to enclose the lot? (30 yd. = _?_ ft.) Remember:

> **When you find perimeter, the dimensions must be in the same units of measure.**

Find the perimeters of pens having these dimensions:

	WIDTH	LENGTH
10.	56′	35 yd.
11.	20 yd.	108′
12.	14 yd. 2 ft.	20 yd.
13.	17 yd. 2 ft.	75′

14. What is the perimeter of a square 64 ft. on a side?



Finding area

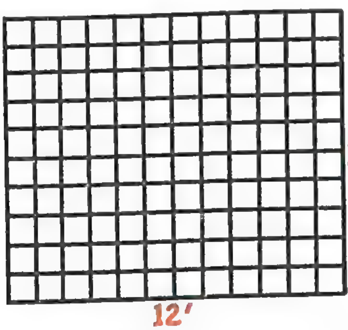
Homer is putting down an asphalt tile floor in his room. Each tile is a square 12 in. (12″) by 12 in. (12″).

Each tile is 1 *square foot* (*sq. ft.*).

1. Draw on the blackboard an exact picture of one of the tiles.

2. Homer's room is 12 ft. (12′) long and 10 ft. (10′) wide.

In one row along the length of his room he needs _?_ tiles.



3. He needs 10 rows of tiles. How can you tell that?

4. In all, Homer needs 10 × 12 tiles, or _?_ tiles.

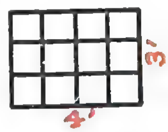
5. The number of squares in a rectangle is its ***area***.

The area of Homer's floor is 10 × 12 sq. ft., or _?_ sq. ft.

6. Make a rule for finding the area of a rectangle. Then compare your rule with this one:

> **The area of a rectangle equals the number of rows times the number of square units in a row.**

7. Use the rule to find the area of this rectangle.



8. The area of a garden 4 yd. wide and 6 yd. long is 4 × 6 square yards, or _?_ sq. yd.

9. The area of a flower border 8 in. wide and 27 in. long is 8 × 27 square inches, or _?_ sq. in.

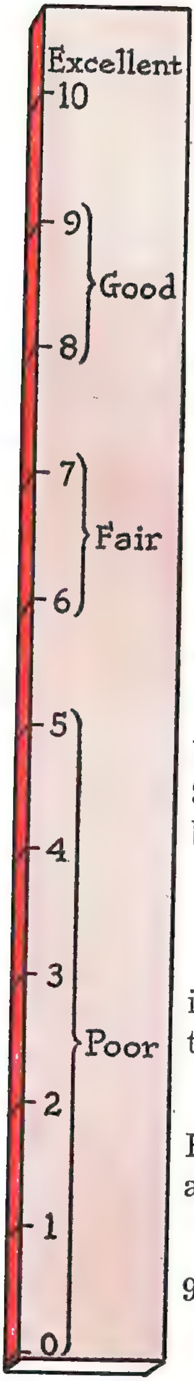
Find the areas of these rectangles:

	a		*b*	
	WIDTH	LENGTH	WIDTH	LENGTH
10.	25′	40′	18 yd.	47 yd.
11.	32″	65″	75 yd.	90 yd.

12. A square may be thought of as a rectangle with all four sides equal.

Find the area of a square whose side is 12 in.; whose side is 3 ft.

Problem Test 2



Measure your growth in problem solving.

1. How much change will you get from $4.00 after buying 4 pairs of woolen socks at 69¢ a pair and an 89-cent T-shirt?

2. If 2 apples make enough salad for 3 persons, you will need _?_ apples for 12 persons.

3. Diana measured and found she needed 288 inches of dotted Swiss for curtains for her room. How many yards should she buy?

4. How much will it cost a boys' club to make a lawn 80′ by 50′ at $1.25 for every 100 square feet of grass?

5. Tim needs a piece of rubber hose $1\frac{1}{2}$ ft. long. If he cuts it from a 5-ft. piece belonging to his father, how much will there be left for his father?

6. When 6 boys were playing ball, they broke the bird-bath in a neighbor's garden. The cost of replacing it was $2.70. If they share the expense equally, what should each boy pay?

7. At $.37$\frac{1}{2}$ a yard, find the cost of 8 yards of chintz.

8. If Richard and his father set out 600 apple trees in an orchard, with 40 trees in a row, how many rows of trees will there be?

9. Tom rents his bicycle to his friends for 10¢ an hour. How much should Ted pay if he uses the bicycle for 1 hr. and 45 min.?

10. Agnes has 3 pieces of red ribbon. Each piece is 2 yd. 9 in. long. How much ribbon has she all together?

Record your score on your Problem Test Record.

Choosing reasonable answers

One of the answers to each example below is correct. Without working the example, choose the answer that seems more likely to be correct. Explain how you decide which answer you think is more likely to be the correct one.

1. $1\frac{1}{4} \times 2\frac{1}{2}$ ($2\frac{1}{8}$; $3\frac{1}{8}$)
   Hint: How can you tell the answer must be more than $2\frac{1}{8}$?
2. $\frac{5}{6} \times 2\frac{2}{5}$ (2; $10\frac{2}{5}$)
   Hint: Could the answer be more than $2\frac{2}{5}$? Is it much less than $2\frac{2}{5}$ or a little less than $2\frac{2}{5}$?
3. $\frac{3}{4} \times 15$ (22; $11\frac{1}{4}$)
4. $6 \times \frac{5}{8}$ ($3\frac{3}{4}$; $30\frac{1}{8}$)
5. $1\frac{2}{3} \times \frac{2}{3}$ ($2\frac{1}{6}$; $1\frac{1}{9}$)
6. $\frac{3}{4} \times \frac{4}{5}$ ($1\frac{2}{3}$; $\frac{3}{5}$)
7. $6 \times 6\frac{3}{4}$ ($36\frac{3}{4}$; $40\frac{1}{2}$)
8. $3\frac{1}{3} \times 10$ ($33\frac{1}{3}$; $30\frac{1}{3}$)
9. $2\frac{5}{6} \times \$1.79$ ($\$7.04\frac{1}{6}$; $\$5.07\frac{1}{6}$)
10. $6\frac{3}{4} + 4\frac{3}{8}$ ($14\frac{5}{8}$; $11\frac{1}{8}$)
11. $16\frac{1}{4} - 2\frac{7}{12}$ ($13\frac{2}{3}$; $14\frac{2}{3}$)
12. $3640 \div 65$ (560; 56)
13. $5 \times \$.37\frac{1}{2}$ ($\$1.87\frac{1}{2}$; $\$2.03\frac{1}{2}$)
14. 49×526 (25,774; 6,838)
15. 50×225 (1,125; 11,250)
16. $\$15 - \$7.93$ ($8.07; $7.07)
17. 21×624 (1304; 13,104)
18. $\frac{2}{3} \times 20$ (30; $13\frac{1}{3}$)
19. $8 \times \frac{3}{7}$ ($3\frac{3}{7}$; $4\frac{1}{7}$)
20. $\frac{7}{8}$ of $\frac{2}{3}$ ($\frac{14}{11}$; $\frac{7}{12}$)
21. $2\frac{3}{4} \times 5$ ($15\frac{1}{4}$; $13\frac{3}{4}$)
22. $2\frac{1}{3} \times \$.72$ ($1.68; $1.86)
23. $9\overline{)3618}$ (42; 402)
24. $28\overline{)1876}$ (57; 67)
25. $30\frac{1}{8} - 2\frac{3}{4}$ ($27\frac{3}{8}$; $28\frac{3}{8}$)
26. $5 \times \$.62\frac{1}{2}$ ($\$3.02\frac{1}{2}$; $\$3.12\frac{1}{2}$)
27. $8\frac{7}{8} + 3\frac{7}{8}$ ($11\frac{7}{8}$; $12\frac{3}{4}$)
28. $\$40 - \$29.82$ ($11.18; $10.18)
29. $200 \times 15\frac{1}{2}$ (2050; 3100)
30. 18×22 (496; 396)
31. $6\frac{1}{8} - 1\frac{1}{4}$ ($5\frac{7}{8}$; $4\frac{7}{8}$)
32. $3\frac{7}{8} \times 6\frac{3}{4}$ ($26\frac{5}{32}$; $33\frac{5}{32}$)
33. $6\frac{9}{16} - 3\frac{11}{16}$ ($3\frac{5}{6}$; $2\frac{7}{8}$)
34. $6 \times \$.98$ ($6.01; $5.88)
35. $\$10 - \$2.98$ ($8.02; $7.02)

A page of review

	a	b	c	d	e
1.	26 45 57 64 60	4624 2809 1608 3888 5075	\$6.54 7.49 5.15 1.09 6.00	\$17.45 18.96 14.60 20.42 21.10	\$72.10 45.11 12.72 18.45 82.09
2.	6604 − 978	1908 − 809	3706 − 1789	\$162.05 − 90.75	\$391.71 − 99.09
3.	658 × 76	587 × 80	809 × 908	597 × 600	4056 × 70
4.	\$2.98 × 75	\$68.40 × 86	\$90.80 × 508	\$148.38 × 90	\$427.91 × 60
5.	$57\overline{)3876}$	$15\overline{)7748}$	$35\overline{)10508}$	$29\overline{)24600}$	$98\overline{)29070}$
6.	$26\overline{)16506}$	$48\overline{)5616}$	$34\overline{)28220}$	$406\overline{)349621}$	$550\overline{)110819}$

7. How much will dinner for 25 boys cost at 55¢ each?

8. How much will 15 airplane tickets cost at \$21.50 each?

9. How many times is 840 contained in 52,080?

10. Add 7,628 + 459 + 6,073.

11. Add \$6.87, \$20.98, and \$27.

12. Find the difference between 855 and 1,050.

13. How much must be added to \$7.98 to make \$10.00?

14. How much is \$12.38 multiplied by 206?

15. Find $\frac{1}{8}$ of 7,264; $\frac{1}{8}$ of 5,048.

16. Which is more, 824 or 9×95?

17. What number times 83 equals 3,108?

Tell what number N stands for:

	a	b
18.	$N \times 17 = 595$	$N - 243 = 101$
19.	$125 \div N = 5$	$432 + N = 700$
20.	$N \div 7 = 100$	$25 \times N = 400$

Self-Help Test 1

If you make mistakes in a Self-Help Test, the number at the right of an example tells you the page on which you can find help. Where can you find help for Ex. 1?

1. 2,687,040,000 is read: 2 _?_, 687 _?_, 40 _?_. **(8–9)**

2. Round off 2,986,428 to the nearest million; to the nearest thousand. **(10)**

3. Change these to better form:

$\frac{12}{8}$ $\qquad 2\frac{10}{8}$ $\qquad 4\frac{20}{6}$ $\qquad \frac{13}{5}$ **(61)**

4. Find the average of 18, 20, 16, 15, and 12. **(54)**

5. A plane traveling at a steady speed of 115 miles an hour will travel how far in 8 hours? **(99)**

6. Find the perimeter of a rectangle $12' \times 10'$. **(120–121)**

7. At 40¢ an hour, how much should Ann receive for taking care of children for 3 hr. 30 min.? **(95)**

8. How long will it take a train to go 600 mi. at 60 mi. an hour? at 40 mi. an hour? **(99)**

9. $4762 \div 386$ **(78)** **10.** $19\overline{)864}$ **(49)**

11. $28\overline{)56112}$ **(75)** **12.** $29\overline{)6538}$ **(52)**

13. Write a fraction to compare 5 eggs with a dozen eggs. **(105)**

14. 30 inches is what part of a yard? **(105)**

15. Find the area of a rectangle $2\frac{1}{2}$ ft. long and 4 ft. wide. **(122)**

Self-Help Test 2

1. $\frac{5}{16} + \frac{5}{16}$ **(65)**

2. $\frac{7}{12} + \frac{7}{12}$ **(65)**

3. $\frac{5}{12} + \frac{3}{4}$ **(66)**

4. $1\frac{4}{5} + \frac{1}{2} + 3\frac{1}{5}$ **(68)**

5. $\frac{7}{8} - \frac{1}{2}$ **(66)**

6. $5 - \frac{3}{4}$ **(70)**

7. $6 - 2\frac{3}{4}$ **(70)**

8. $3\frac{1}{2} - \frac{4}{5}$ **(72)**

9. $9 \times \frac{2}{3}$ **(86)**

10. $\frac{3}{4} \times \frac{5}{12}$ **(90)**

11. $\frac{2}{3} \times \frac{6}{7}$ **(90)**

12. $\frac{3}{4} \times 9$ **(91)**

13. $\frac{3}{5}$ of 8 **(91)**

14. $1\frac{3}{4} \times 8$ **(95)**

15. $6 \times 2\frac{1}{3}$ **(115)**

16. $\frac{4}{5} \times 2\frac{1}{2}$ **(110)**

17. $1\frac{1}{3} \times \frac{3}{8}$ **(110)**

18. $8\frac{1}{4} \times 1\frac{1}{3}$ **(111)**

Measuring your growth in arithmetic

Copy all numbers correctly. Work carefully. Check your answers. Be sure your answers are sensible.

1. $\frac{2}{3} \times \frac{9}{10}$

2. $1\frac{3}{4} \times 1\frac{3}{5}$

3. $12 \times 3\frac{1}{3}$

4. $18 \times \$.87\frac{1}{2}$

5. Find the area of a rectangular skating rink 88 ft. long and 30 ft. wide.

6. Betty timed herself while reading a book of adventure stories. It took her 5 minutes to read 20 pages.

How long will it take her to read the remaining 160 pages in the book?

7. At 28¢ a dozen, find the cost of 30 sweet breakfast rolls; of 42 rolls and $1\frac{1}{2}$ lb. of butter at 75¢ a pound.

8. The Thomas Jefferson Elementary School was built in the year MCMXVII.

Was the school built in 1917? 1827? 1927?

9. Candy-coated peanuts are selling at 80¢ a pound.

Tom has a nickel and 5 pennies. How many ounces of the peanuts can he get for the money he has?

10. Patty's recipe for chocolate cookies calls for $\frac{3}{8}$ lb. of bitter chocolate. She wants to make $\frac{1}{3}$ of the recipe.

How much chocolate should Patty use?

Just for fun

1. Here the figure 6 is written six times in such a way that the result equals 100.

$$\boxed{\frac{666 - 66}{6} = 100}$$

See if you can work out a similar way to use the figure 8 eight times, so that the result you will get equals 1000.

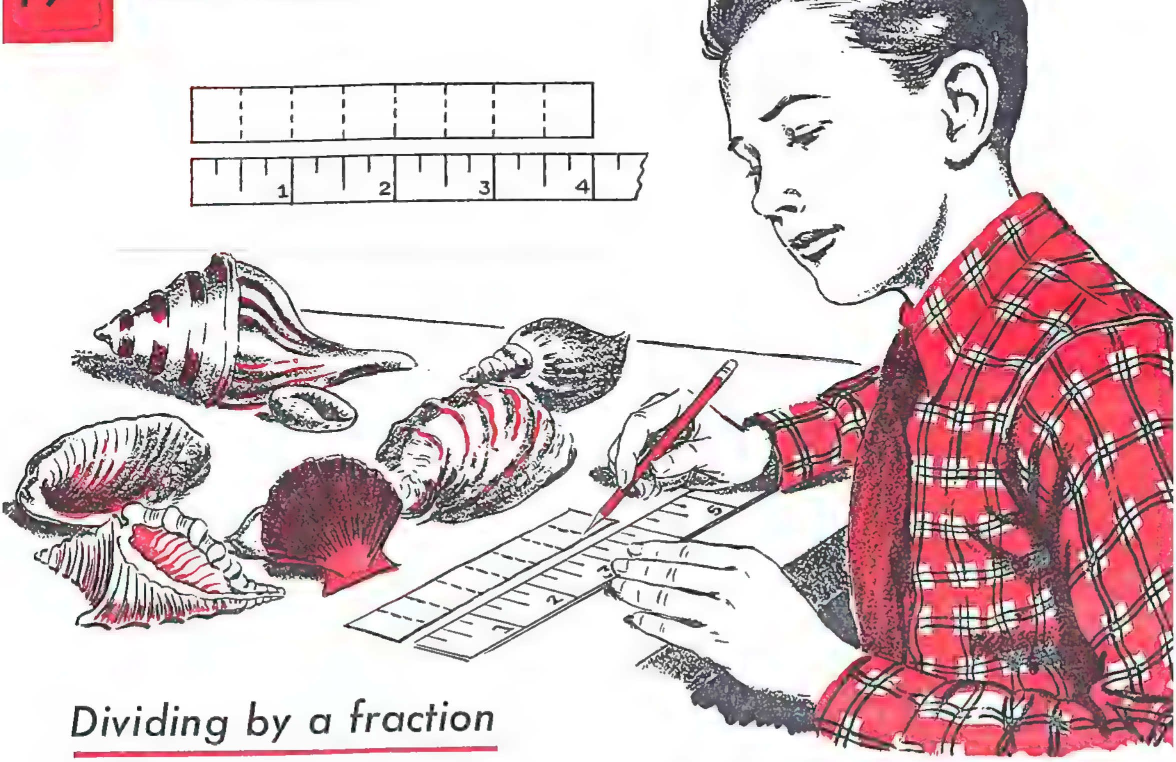
2. Jim arranged some cards and matches to make this untrue statement:

$$\boxed{\tfrac{1}{2}} - \boxed{1} = \boxed{\tfrac{1}{2}}$$

By moving one match can you make a true statement out of Jim's cards and matches? Do not move any of the cards.

UNIT 19

Dividing whole numbers by fractions (unit or multiple) or mixed numbers. Dividing fractions by fractions or whole numbers



Dividing by a fraction

Philip has a 4-inch strip of gummed tape. He wants to cut it into pieces $\frac{1}{2}$ in. long to make labels for the shells in his shell collection.

1. How many $\frac{1}{2}$-inch pieces can Philip cut from 4 inches of tape? Study the picture.

Count the number of *half inches* contained in 1 inch; in 2 inches; 3 inches; 4 inches.

2. The division, $4 \div \frac{1}{2} =$?, asks the question, "How many $\frac{1}{2}$'s are there in 4?"

The answer is ?. There are 8 halves in 4.

3. Can you tell from the picture of the ruler how many $\frac{1}{4}$ inches there are in 1 inch? in 2 inches? 3 inches? 4 inches?

4. $4 \div \frac{1}{4} =$? asks the question, "How many $\frac{1}{4}$'s are there in 4?" The answer is ?.

5. Look at a ruler. How many $\frac{1}{8}$ inches are there in 1 inch? in 2 inches? 3 inches?

6. What question does this division ask? $3 \div \frac{1}{8} =$?.

What is the answer?

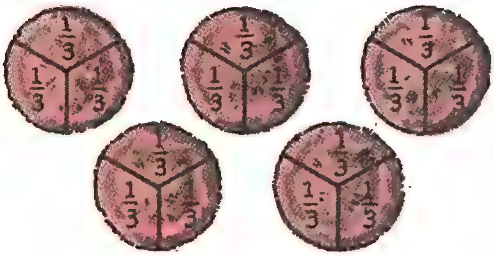
7. How many $\frac{1}{8}$ inches are there in 4 inches? $4 \div \frac{1}{8} =$?.

Use a ruler to show that:

8. $3 \text{ in.} \div \frac{1}{2} \text{ in.} = 3 \times 2 = 6$

9. $5 \text{ in.} \div \frac{1}{4} \text{ in.} = 5 \times 4 = 20$

10. $4 \text{ in.} \div \frac{1}{8} \text{ in.} = 4 \times 8 = 32$



11. Use the pies above to find how many $\frac{1}{3}$'s there are in 1; in 2; in 3; in 4; in 5.

12. The first question below asks, "How many $\frac{1}{3}$'s are there in 2?" What question does each of the other divisions ask?

$2 \div \frac{1}{3} = ?$	$4 \div \frac{1}{3} = ?$
$3 \div \frac{1}{3} = ?$	$5 \div \frac{1}{3} = ?$

13. Use the pies above to explain these divisions:

- $2 \div \frac{1}{3} = 2 \times 3 = 6$
- $3 \div \frac{1}{3} = 3 \times 3 = 9$
- $4 \div \frac{1}{3} = 4 \times 3 = 12$
- $5 \div \frac{1}{3} = 5 \times 3 = 15$

14. In $2 \div \frac{1}{3} = 6$, what is the dividend? the divisor? the quotient? How can you prove the division is correct?

15. How many $\frac{1}{2}$'s are there in 1? in 2? in 6? in 8? in 10?

16. $6 \div \frac{1}{4} = \underline{\ ?\ }$ asks the question, "How many $\frac{1}{4}$'s are there in $\underline{\ ?\ }$."

How many $\frac{1}{4}$'s are there in 1? in 2? in 3? in 6?

Does $6 \div \frac{1}{4} = 6 \times 4 = 24$?

17. Make up a rule for finding:

- how many $\frac{1}{3}$'s there are in any whole number.
- how many $\frac{1}{2}$'s there are in any whole number.
- how many $\frac{1}{4}$'s there are in any whole number.
- how many $\frac{1}{8}$'s there are in any whole number.

18. Make a drawing to show how many servings of $\frac{1}{4}$ cantaloupe you can get from 3 cantaloupes.

19. Write the division you would use in finding the answer to Ex. 18.

20. If you start with 4 and subtract $\frac{1}{2}$ over and over, how many subtractions can you do?

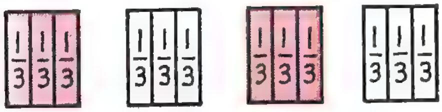
21. Write a division that asks how many servings of $\frac{1}{5}$ pie you can cut from 3 pies.

22. Write a division that asks how many $\frac{1}{4}$-lb. sticks of butter you get in 4 lb. of butter.

23. Write a division that asks how many quarters you get for 5 dollars.

Dividing by a fraction

1. To find how many $\frac{1}{3}$'s there are in 4, Nancy drew 4 rectangles and divided each into thirds.

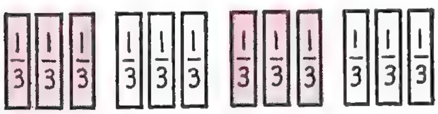


In 4 rectangles there are 4×3 thirds, or __?__ thirds.

$$4 \div \frac{1}{3} = 4 \times 3 = \underline{\ ?\ }$$

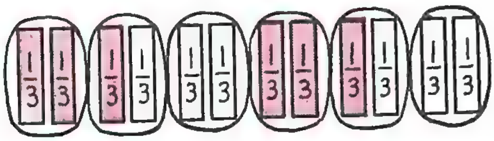
2. Bill needed to find how many $\frac{2}{3}$'s there are in 4; that is, $4 \div \frac{2}{3}$. He took Nancy's drawing of 4 rectangles (Ex. 1 above) and cut apart the thirds as shown below.

Did he use all 4 of the rectangles? Did he use all 12 of the one thirds?



3. Then Bill said, "I'll group the first 2 of the $\frac{1}{3}$'s together; then I'll group the next 2; and so on."

Below you can see how his grouping looked then.



Bill's work shows that out of 12 thirds you can make __?__ groups with 2 thirds in each group.

4. How does the drawing in Ex. 3 show the six $\frac{2}{3}$'s in 4?

5. What question does this division ask? $4 \div \frac{2}{3} = \underline{\ ?\ }$. What is the answer?

6. Without the help of pictures, find how many $\frac{2}{3}$'s there are in 4:

- First ask yourself, "How many $\frac{1}{3}$'s are there in 4?"

(*Answer:* In 1 there are 3 thirds; so in 4 there are 4×3 thirds, or 12 thirds.)

- Then ask, "How many groups of 2 thirds are there in 12 thirds?"

(*Answer:* The number of 2 thirds in 12 thirds is $12 \div 2$, or __?__.)

7. Find how many $\frac{2}{3}$'s there are in 6 this way:

- How many $\frac{1}{3}$'s are there in 6?
- How many 2 thirds are there in 18 thirds?
- What question does this division ask? $6 \div \frac{2}{3} = \underline{\ ?\ }$. What is the answer?

8. Find how many $\frac{2}{3}$'s there are in 8 this way:

- How many $\frac{1}{3}$'s are there in 8?
- How many 2 thirds are there in 24 thirds?
- What question does this division ask? $8 \div \frac{2}{3} = \underline{\ ?\ }$. What is the answer?

To the Teacher: See Note 6 on page 310.

9. Make a rule for finding how many $\frac{2}{3}$'s there are in any number.

Hint: First find how many $\frac{1}{3}$'s there are in the number.

10. Tom wanted to divide 12 by $\frac{2}{3}$. He thought, "$12 \div \frac{1}{3} = 36$; so $12 \div \frac{2}{3}$ is $\frac{36}{2}$, or __?__." Was he right?

11. To do the division $12 \div \frac{2}{3}$, Tom wrote: $12 \div \frac{2}{3} = \frac{12 \times 3}{2} =$ __?__.

12. May wanted to divide 12 by $\frac{3}{4}$. She thought, "$12 \div \frac{1}{4} = 12 \times 4$; so $12 \div \frac{3}{4} = \frac{12 \times 4}{3} =$ __?__"

13. Bill said, "When I want to divide a number by $\frac{3}{4}$, I first multiply it by 4 and then divide the product by 3." Would Bill's rule work with the example in Ex. 12?

14. Jane said she had a good rule for dividing a number by a fraction. "I multiply the number by the denominator of the fraction; then I divide the product by the numerator of the fraction."

Test Jane's rule with the division in Ex. 12.

15. To do the division $15 \div \frac{3}{4}$, Jane would first find 15×4. What would she do then?

Complete the division:

$$15 \div \frac{3}{4} = \frac{15 \times 4}{3} = \underline{\ ?\ }.$$

16. Most "grownups" would do the division in Ex. 15 this way:

$$15 \div \frac{3}{4} = \frac{\overset{5}{\cancel{15}}}{1} \times \frac{4}{\underset{1}{\cancel{3}}} = \frac{20}{1} = 20$$

Explain this "grownup" way.

17. Notice that the "grownup" way in Ex. 16 changes the division into a multiplication.

Dividing by $\frac{3}{4}$ is the same as multiplying by $\frac{4}{3}$. The divisor $\frac{3}{4}$ is *inverted* (turned upside down); the $\frac{3}{4}$ then becomes $\frac{4}{3}$.

- Does $15 \div \frac{3}{4} = 15 \times \frac{4}{3}$?
- Does $12 \div \frac{2}{3} = 12 \times \frac{3}{2}$?
- Does $12 \div \frac{3}{4} = 12 \times \frac{4}{3}$?

18. Here is a short rule for dividing by a fraction. Explain why it works.

> **To divide a whole number by a fraction, invert the divisor and multiply.**

Tell how these divisions are done. Complete each one.

19. $8 \div \frac{2}{3} = \frac{\overset{4}{\cancel{8}}}{1} \times \frac{3}{\underset{1}{\cancel{2}}} = \frac{12}{1} = \underline{\ ?\ }$

20. $4 \div \frac{3}{5} = \frac{4}{1} \times \frac{5}{3} = \frac{20}{3} = \underline{\ ?\ }$

21. $3 \div \frac{3}{8} = \frac{\overset{1}{\cancel{3}}}{1} \times \frac{8}{\underset{1}{\cancel{3}}} = \frac{8}{1} = \underline{\ ?\ }$

22. $6 \div \frac{4}{5} = \frac{\overset{3}{\cancel{6}}}{1} \times \frac{5}{\underset{2}{\cancel{4}}} = \frac{15}{2} = \underline{\ ?\ }$

Problems and practice

1. How many strips of paper $\frac{5}{8}$ in. wide can Mary cut from a strip of paper 5 in. wide?

2. How many towels 30 inches ($\frac{5}{6}$ yd.) long can Fay make from 5 yd. of toweling? from 10 yd.?

3. How many tent stakes $\frac{1}{3}$ yd. long can Dick cut from a stick 4 yd. long?

4. If Jack can walk the mile from the trailer camp to the village in a quarter hour, how many miles can he walk in 1 hr.? in 4 hr.?

5. Wendy plans to cut melons so that each serving will be $\frac{1}{3}$ of a melon. How many servings can she get from 4 melons? 5 melons?

6. A vacuum-bottle top holds $\frac{1}{4}$ pt. of liquid. How many times can it be filled from 2 qt. of liquid?

7. It takes a bus $\frac{3}{4}$ hr. to go from Weston to Irving and back. How many round trips can the bus make between 9:00 A.M. and noon?

8. A cooking class has 6 lb. of sugar. How many batches of candy, each requiring $\frac{3}{4}$ lb. of sugar, can the class make?

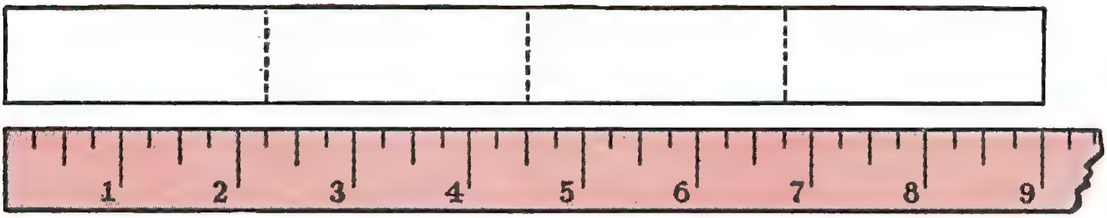
9. Don bought a 5-lb. bag of chicken feed. If he uses $\frac{5}{8}$ lb. of it each day, how many days will it last?

10. When you divide a whole number by a proper fraction, will the answer always be larger than the whole number or smaller than the whole number?
Give a reason for your answer. Then prove your answer by an illustration.

Divide. Show that each answer is sensible.

	a	*b*	*c*	*d*	*e*	*f*
11.	$6 \div \frac{2}{3}$	$12 \div \frac{4}{5}$	$24 \div \frac{3}{5}$	$15 \div \frac{2}{5}$	$11 \div \frac{3}{8}$	$12 \div \frac{5}{6}$
12.	$5 \div \frac{3}{4}$	$10 \div \frac{5}{6}$	$25 \div \frac{3}{4}$	$14 \div \frac{7}{8}$	$19 \div \frac{2}{5}$	$8 \div \frac{5}{8}$
13.	$8 \div \frac{2}{5}$	$16 \div \frac{2}{3}$	$18 \div \frac{2}{3}$	$20 \div \frac{2}{3}$	$12 \div \frac{3}{5}$	$16 \div \frac{2}{5}$
14.	$7 \div \frac{4}{5}$	$15 \div \frac{3}{4}$	$20 \div \frac{4}{5}$	$18 \div \frac{3}{8}$	$10 \div \frac{5}{8}$	$16 \div \frac{3}{8}$
15.	$8 \div \frac{5}{8}$	$16 \div \frac{1}{5}$	$12 \div \frac{3}{4}$	$32 \div \frac{2}{3}$	$16 \div \frac{5}{8}$	$18 \div \frac{3}{4}$

Dividing whole numbers by mixed numbers



Bruce has a stamp collection. He keeps his extra stamps in matchboxes and labels the boxes "Italy," "Brazil," and so on.

1. Bruce wants to make more labels for his matchboxes. If he decides that each label should be $2\frac{1}{4}$ in. long, how many labels can he make with a strip of gummed tape 9 in. long?

Look at the ruler above. Think:

▶ One label uses $2\frac{1}{4}$ in.

▶ Two labels use $2\frac{1}{4}$ in. + $2\frac{1}{4}$ in., or $4\frac{1}{2}$ in.

▶ Three labels use $2\frac{1}{4}$ in. + $2\frac{1}{4}$ in. + $2\frac{1}{4}$ in., or $6\frac{3}{4}$ in.

▶ Four labels use $\underline{\ ?\ }$ in.

2. $9 \div 2\frac{1}{4} = \underline{\ ?\ }$ asks the question, "How many times is $2\frac{1}{4}$ contained in 9?" The answer is $\underline{\ ?\ }$.

3. Explain this short way of dividing 9 by $2\frac{1}{4}$. Notice that the mixed number $2\frac{1}{4}$ is changed to the $\underline{\ ?\ }$ fraction, $\frac{9}{4}$. The 9 is written as the fraction $\frac{9}{1}$.

$$9 \div 2\frac{1}{4} = \frac{9}{1} \div \frac{9}{4} = \frac{\overset{1}{\cancel{9}}}{1} \times \frac{4}{\underset{1}{\cancel{9}}} = 4$$

4. How many labels $2\frac{1}{2}$ in. long can be cut from 10 in. of gummed tape?

$$10 \div 2\frac{1}{2} = \frac{10}{1} \div \frac{?}{2} = \frac{\overset{2}{\cancel{10}}}{1} \times \frac{2}{\underset{1}{\cancel{5}}} = \underline{\ ?\ }$$

5. How many labels $1\frac{1}{4}$ in. long can be cut from 12 in. of gummed tape?

$$12 \div 1\frac{1}{4} = \frac{12}{1} \div \frac{?}{4} = \frac{12}{1} \times \frac{4}{5} = \frac{48}{5} = \underline{\ ?\ }$$

6. When you divide a whole number by a mixed number, will the answer always be larger than the whole number or smaller than the whole number?

Give a reason for your answer. Then prove your answer by an illustration.

Without doing these divisions, choose the sensible answer to each:

7. Does $12 \div 2\frac{1}{2} = 4\frac{4}{5}$, or $10\frac{1}{3}$?

8. Does $15 \div 2\frac{1}{2} = 2$, or 6?

9. Does $16 \div \frac{4}{5} = 20$, or 12?

10. Does $20 \div 1\frac{1}{3} = 21$, or 15?

Problems and practice

1. If Allan feeds his goats $2\frac{1}{2}$ lb. of mixed grain each day, how long will a 10-lb. bag of grain last? a 15-lb. bag?

2. On a wet, oily stretch of road, it took Dan's father $2\frac{1}{4}$ hr. to drive 45 mi. "That is only _?_ miles an hour," said Dan.

3. Clifford has a piece of shelving 12 ft. long. He wants to make a shelf under each of 5 windows in the club shack. The windows are $2\frac{1}{4}$ ft. wide.

Is the shelving long enough? Will there be any shelving left over? How much?

4. How many strips $3\frac{3}{4}$ in. wide can Lois cut from a piece of material 30 in. wide?

5. How many pairs of shoes that cost $\$4\frac{1}{2}$ a pair can you get for \$20?

6. Ann says the answer to Ex. 5 is $4\frac{4}{9}$ pairs. George says the answer is 4 pairs.

Who uses more common sense in arithmetic, Ann or George?

7. Estimate the answer to each division in Exs. 8–12. Estimate the first answer this way:

▶ $2\frac{2}{3}$ is more than 2, but less than 3.

▶ $16 \div 2 = 8$ $\qquad$ $16 \div 3 = 5\frac{1}{3}$

▶ The answer to $16 \div 2\frac{2}{3}$ must be between 8 and $5\frac{1}{3}$.

▶ The answer will be closer to 5 than to 8.

(Why will the answer be closer to 5 than to 8? Hint: Is $2\frac{2}{3}$ closer to 2 or to 3? Then will the answer be closer to $16 \div 2$ or to $16 \div 3$?)

▶ The answer to $16 \div 2\frac{2}{3}$ is about 6.

Do these divisions:

	a	*b*	*c*	*d*	*e*
8.	$16 \div 2\frac{2}{3}$	$18 \div 2\frac{1}{3}$	$45 \div 7\frac{1}{2}$	$30 \div 3\frac{1}{3}$	$21 \div 2\frac{1}{4}$
9.	$15 \div 1\frac{3}{5}$	$12 \div 2\frac{2}{5}$	$35 \div 3\frac{1}{2}$	$16 \div 3\frac{1}{5}$	$20 \div 3\frac{1}{3}$
10.	$12 \div 2\frac{1}{4}$	$14 \div 1\frac{2}{5}$	$24 \div 2\frac{2}{5}$	$18 \div 4\frac{1}{2}$	$30 \div 3\frac{1}{2}$
11.	$15 \div 4\frac{1}{2}$	$27 \div 1\frac{1}{3}$	$19 \div 1\frac{1}{3}$	$25 \div 1\frac{1}{4}$	$16 \div 6\frac{2}{3}$
12.	$11 \div 2\frac{1}{8}$	$21 \div 4\frac{1}{2}$	$15 \div 3\frac{1}{2}$	$20 \div 6\frac{2}{3}$	$18 \div 1\frac{1}{2}$

Dividing money by a mixed number

1. Jim and Peter bought a piece of ticking for bunk covers. It contained $4\frac{1}{2}$ yards and cost \$2.25. What was the cost per yard?

▶ Jim thought, "If we had bought 5 yards for \$2.25, to find the cost of one yard we should divide \$2.25 by 5. But we bought $4\frac{1}{2}$ yd.; so we divide \$2.25 by $4\frac{1}{2}$."

▶ Here is Jim's work. How did he change the \$2.25? the $4\frac{1}{2}$?

$$\$2.25 \div 4\tfrac{1}{2} =$$
$$\frac{\$2.25}{1} \div \frac{9}{2} = \frac{\overset{\$.25}{\cancel{2.25}}}{1} \times \frac{2}{\underset{1}{\cancel{9}}} = \$.50$$

▶ Jim checked: "$4\frac{1}{2} \times \$.50$ should equal \$2.25." Does it?

2. Peter bought a $12\frac{1}{2}$-ft. piece of screening for \$2.75. How much did he pay per foot?

$$\$2.75 \div 12\tfrac{1}{2} = \frac{\$2.75}{1} \div \frac{25}{2} = \frac{\overset{\$\ .11}{\cancel{\$2.75}}}{1} \times \frac{2}{\underset{1}{\cancel{25}}} = \underline{\ ?\ }$$

What did Peter do to the $12\frac{1}{2}$ before dividing?

3. Estimate the answers in Exs. 4–9. In Ex. 4, think:

- \$4.20 ÷ 1 = \$4.20
- \$4.20 ÷ 2 = \$2.10
- \$4.20 ÷ $1\frac{3}{4}$ is between \$2.10 and \$4.20, and is nearer \$2.10.

Do these divisions. Check.

4. \$4.20 ÷ $1\frac{3}{4}$

5. \$2.45 ÷ $2\frac{1}{3}$

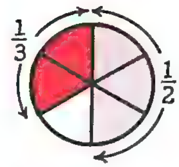
6. \$4.40 ÷ $2\frac{1}{5}$

7. \$2.25 ÷ $4\frac{1}{2}$

8. \$4.50 ÷ $2\frac{1}{4}$

9. \$2.40 ÷ $2\frac{2}{3}$

Dividing a fraction by a fraction



1. $\frac{1}{2} \div \frac{1}{6} = \underline{\ ?\ }$ asks the question, "How many $\frac{1}{6}$'s are there in $\frac{1}{2}$?" The circle at the right shows there are $\underline{\ ?\ }$ $\frac{1}{6}$'s in $\frac{1}{2}$. $\frac{1}{2} \div \frac{1}{6} = 3$ means that there are three $\frac{1}{6}$'s in $\frac{1}{2}$.

2. $\frac{1}{3} \div \frac{1}{6} = \underline{\ ?\ }$ asks the question, "How many $\frac{1}{6}$'s are there in $\underline{\ ?\ }$." Use the circle to find the answer. $\frac{1}{3} \div \frac{1}{6} = 2$ means that there are $\underline{\ ?\ }$ $\frac{1}{6}$'s in $\frac{1}{3}$.

3. What question does this division ask? $\frac{1}{2} \div \frac{1}{4} = \underline{\ ?\ }$. Draw a diagram to find the answer.

4. Jane had $\frac{3}{4}$ lb. of salted peanuts to put into paper bags. To put 3 ounces ($\frac{3}{16}$ of a pound) into each bag, she needed $\underline{\ ?\ }$ bags.

Jane needed to answer the question, "How many $\frac{3}{16}$'s are there in $\frac{3}{4}$?" She wrote: $\frac{3}{4} \div \frac{3}{16} = \underline{\ ?\ }$. Jane did this work and decided that she needed $\underline{\ ?\ }$ bags.

$$\boxed{\frac{3}{4} \div \frac{3}{16} = \frac{\overset{1}{\cancel{3}}}{\underset{1}{\cancel{4}}} \times \frac{\overset{4}{\cancel{16}}}{\underset{1}{\cancel{3}}} = 4}$$

5. To check her answer, Jane (Ex. 4) thought, "4 bags will hold $4 \times \frac{3}{16}$ of a pound, or $\underline{\ ?\ }$ of a pound."

Copy and complete these divisions:

6. $\frac{2}{3} \div \frac{1}{12} = \frac{2}{\underset{1}{\cancel{3}}} \times \frac{\overset{4}{\cancel{12}}}{1} = \underline{\ ?\ }$

7. $\frac{4}{5} \div \frac{1}{2} = \frac{4}{5} \times \frac{2}{1} = \underline{\ ?\ }$

8. $\frac{3}{4} \div \frac{1}{3} = \frac{3}{4} \times \frac{3}{1} = \underline{\ ?\ }$

9. How many pieces of string $\frac{1}{8}$ yd. long can be cut from a piece $\frac{7}{8}$ yd. long?

10. Do a division to show how many $\frac{1}{4}$-lb. bags of potato chips you should buy if you want $\frac{1}{2}$ lb. of potato chips.

11. Do a division to show how many 2-oz. ($\frac{1}{8}$ lb.) bags of popcorn you should buy if you want $\frac{3}{4}$ lb.

Do these divisions:

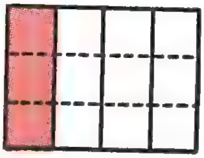
	a	b	c
12.	$\frac{4}{5} \div \frac{3}{10}$	$\frac{1}{2} \div \frac{1}{3}$	$\frac{3}{10} \div \frac{1}{2}$
13.	$\frac{3}{4} \div \frac{3}{16}$	$\frac{1}{2} \div \frac{3}{16}$	$\frac{5}{12} \div \frac{3}{4}$
14.	$\frac{2}{3} \div \frac{1}{2}$	$\frac{7}{8} \div \frac{2}{3}$	$\frac{7}{16} \div \frac{3}{8}$
15.	$\frac{5}{6} \div \frac{1}{2}$	$\frac{2}{3} \div \frac{7}{12}$	$\frac{7}{10} \div \frac{3}{5}$
16.	$\frac{1}{2} \div \frac{4}{5}$	$\frac{2}{3} \div \frac{2}{5}$	$\frac{9}{10} \div \frac{3}{5}$

17. Which division below illustrates that when a fraction is divided by a fraction, the answer can be a whole number? a proper fraction? a mixed number?

$\frac{1}{2} \div \frac{1}{4} = \underline{\ ?\ }$ $\quad$ $\frac{1}{8} \div \frac{1}{2} = \underline{\ ?\ }$ $\quad$ $\frac{3}{4} \div \frac{1}{3} = \underline{\ ?\ }$

Dividing a fraction by a whole number

1. What part of this rectangle is red? →



2. The same rectangle is now divided into three equal parts by dotted lines: →
Point to $\frac{1}{3}$ of the rectangle.

3. In all, the rectangle is now divided into $\underline{?}$ equal parts. Point to $\frac{1}{12}$ of the rectangle.

4. The red $\frac{1}{4}$ of the rectangle is divided into $\underline{?}$ equal parts by the dotted lines. Is each small part $\frac{1}{12}$ of the rectangle?

5. Does the red section of the rectangle show that $\frac{1}{4} \div 3 = \frac{1}{12}$?

6. You do not need a picture to divide $\frac{1}{4}$ by 3. You can divide $\frac{1}{4}$ by 3, just as you divide $\frac{1}{4}$ by a fraction. Explain how it is done below.

$$\boxed{\frac{1}{4} \div 3 = \frac{1}{4} \div \frac{3}{1} = \frac{1}{4} \times \frac{1}{3} = \frac{1}{12}}$$

7. Each half of this pie is cut into 3 equal parts. Each serving is $\frac{1}{6}$ of the pie.
The pie shows that $\frac{1}{2} \div 3 = \frac{1}{?}$.

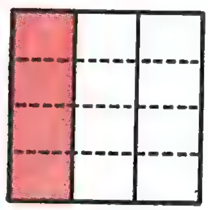
8. What does this division show? $\frac{1}{2} \div 3 = \frac{1}{2} \div \frac{3}{1} = \frac{1}{2} \times \frac{1}{3} = \frac{1}{?}$

9. Each half of this cake is cut into 5 equal parts. Each serving is $\frac{1}{10}$ of the cake.
The cake shows that $\frac{1}{2} \div 5 = \frac{1}{?}$.

10. What does this division show? $\frac{1}{2} \div 5 = \frac{1}{2} \div \frac{5}{1} = \frac{1}{2} \times \frac{1}{5} = \frac{1}{?}$

	a	*b*	*c*
11.	$\frac{1}{2} \div 5$	$\frac{3}{8} \div 6$	$\frac{5}{12} \div 10$
12.	$\frac{2}{3} \div 3$	$\frac{5}{8} \div 5$	$\frac{3}{4} \div 15$
13.	$\frac{3}{4} \div 12$	$\frac{5}{6} \div 2$	$\frac{4}{5} \div 10$
14.	$\frac{2}{3} \div 8$	$\frac{3}{10} \div 6$	$\frac{3}{5} \div 12$

15. If Susan divides $\frac{3}{4}$ of a cake into 6 equal slices, what part of the whole cake will each of these slices be?



16. The red $\frac{1}{3}$ of this rectangle is divided into $\underline{?}$ equal parts by the dotted lines. Does each part of the red third make $\frac{1}{12}$ of the rectangle?

17. Ex. 16 shows that $\frac{1}{3} \div 4 = \frac{1}{?}$.

18. Do a division to show how much $\frac{1}{3}$ divided by 4 equals.

Thinking about fractions

$12 \div 4 = 3$
$12 \div 2 = 6$
$12 \div 1 = 12$
$12 \div \frac{1}{2} = 24$
$12 \div \frac{1}{4} = 48$

How many pieces of ribbon will you have if you cut a 12-inch piece of ribbon into 4-inch lengths?

How many pieces will you have if you cut it into 2-inch lengths? into 1-inch lengths? into $\frac{1}{2}$-inch lengths? into $\frac{1}{4}$-inch lengths?

Some people have the idea that the answer to a division example is always smaller than the dividend. Do you think that is true?

In each example estimate whether your answer will be smaller or larger than the dividend. Then work the example.

	a	*b*	*c*	*d*	*e*
1.	$42 \div 6$	$15 \div \frac{1}{4}$	$32 \div 4$	$42 \div \frac{1}{6}$	$42 \div \frac{3}{2}$
2.	$32 \div 5$	$15 \div 4$	$32 \div \frac{4}{5}$	$20 \div \frac{5}{6}$	$30 \div \frac{5}{6}$
3.	$24 \div \frac{1}{3}$	$20 \div \frac{1}{8}$	$40 \div 8$	$40 \div \frac{1}{8}$	$40 \div \frac{5}{8}$
4.	$16 \div \frac{4}{3}$	$16 \div \frac{2}{5}$	$48 \div \frac{1}{3}$	$48 \div \frac{2}{3}$	$75 \div \frac{5}{4}$
5.	$25 \div \frac{2}{3}$	$25 \div 3$	$25 \div \frac{3}{2}$	$25 \div \frac{1}{4}$	$25 \div \frac{3}{4}$

6. Dividing a whole number by a *proper* fraction always gives you an answer larger than the dividend. Why? Give illustrations.

7. To find how many $\frac{1}{4}$-yard lengths she could cut from 5 yards of ribbon, Betty thought, "From 1 yard I can cut 4 pieces, each $\frac{1}{4}$ yard long; so from 5 yards I can cut 5×4, or ? pieces."

8. What would Betty think in finding how many $\frac{1}{8}$-yd. lengths she could cut from 4 yd. of ribbon?

9. Suppose you had 3 one-dollar bills changed into quarters. How many quarters would you get?

10. Which of these divisions would you use to solve Ex. 9? Explain.

- $3 \div \frac{1}{4} = 3 \times \frac{4}{1} = 12$
- $4 \div \frac{1}{3} = 4 \times \frac{3}{1} = 12$

11. If you already know that $5 \div \frac{3}{4} = 6\frac{2}{3}$, then you can tell:

- that $2\frac{1}{2} \div \frac{3}{4} =$?
- that $5 \div 1\frac{1}{2} =$?
- that $5 \div \frac{3}{8} =$?

Arithmetic roundup

1. $\begin{array}{r} 4070 \\ -\ 1065 \\ \hline \end{array}$ **2.** $\begin{array}{r} \$50.00 \\ -\ 17.98 \\ \hline \end{array}$ **3.** $\begin{array}{r} 685 \\ \times\ 79 \\ \hline \end{array}$ **4.** $\begin{array}{r} \$29.98 \\ \times\ 85 \\ \hline \end{array}$

5. $466 + 279 + 884 + 698 + 589$

6. $\$67.85 + \$15.98 + \$84.69 + \$21.59 + \$6.77$

7. Divide 8,580 by 42.

8. Add: $3\frac{7}{10}$, $4\frac{3}{5}$, $6\frac{1}{2}$.

9. $21{,}126 \div 56 =$ _?_.

10. From $16\frac{1}{2}$ take $8\frac{7}{12}$.

11. Copy and complete:

6 min. 20 sec. = _?_ sec.
5 ft. 8 in. = _?_ in.
8 gal. 3 qt. = _?_ qt.
4 bu. 6 pk. = _?_ pk.

12. Change to improper fractions: $3\frac{3}{5}$ $7\frac{5}{6}$ $2\frac{2}{3}$ $5\frac{4}{5}$ $3\frac{3}{4}$ $2\frac{3}{10}$

13. Express in simplest form: $\frac{10}{4}$ $\frac{15}{6}$ $\frac{21}{5}$ $\frac{38}{4}$ $\frac{43}{10}$ $\frac{10}{3}$

14. How many boxes, each holding a dozen eggs, can be filled from a crate of 360 eggs?

15. Find the cost of $6\frac{1}{2}$ yd. of fringe at $7\frac{1}{2}$¢ a yard.

16. When oranges sell at 6 for 15¢, how many will you get for a nickel? Draw a picture.

17. How many hours will Claire practice on the piano in a week if she practices $1\frac{1}{2}$ hr. every day except Sunday?

18. If you buy 15 cents' worth of nuts that sell for 60¢ a pound, how many ounces of nuts will you get?

19. A truck that holds 3 tons can carry _?_ times as large a load as one that holds $\frac{3}{4}$ ton.

20. How far will a jeep go in $2\frac{1}{2}$ hr. if it travels 45 miles an hour?

21. A motorcycle traveled 150 miles in 3 hr. It traveled at an average rate of _?_ miles an hour.

22. 60¢ is what part of a dollar?

23. 12 oz. is what part of a pound?

24. 27 in. is what part of a yard?

25. Take the tests on pages 305–308.

UNIT 20

Dividing mixed numbers by fractions, whole numbers, or mixed numbers; fractions by mixed numbers

Dividing a mixed number by a fraction

Jean is making hair bands like the one she has on for all the girls in her club.

She has $5\frac{1}{3}$ yards of ribbon. She uses 24 inches ($\frac{2}{3}$ yd.) of ribbon for each band. How many bands can she make?

Jean thought, "If one band takes $\frac{2}{3}$ of a yard, I can make as many bands from $5\frac{1}{3}$ yards as there are $\frac{2}{3}$'s in $5\frac{1}{3}$.

"I must divide $5\frac{1}{3}$ by $\frac{2}{3}$."

1. This is how Jean divided $5\frac{1}{3}$ by $\frac{2}{3}$. Explain her work.

$$5\frac{1}{3} \div \frac{2}{3} = \frac{16}{3} \div \frac{2}{3} = \frac{\cancel{16}^{\,8}}{\cancel{3}_{\,1}} \times \frac{\cancel{3}^{\,1}}{\cancel{2}_{\,1}} = \underline{\ ?\ }$$

2. Does Jean's division in Ex. 1 show that she can get 8 bands, each $\frac{2}{3}$ yard long, out of $5\frac{1}{3}$ yards of ribbon? Check by multiplying.

3. Copy, complete, and check:

$$2\frac{1}{4} \div \frac{3}{5} = \frac{9}{4} \div \frac{3}{5} = \frac{\cancel{9}^{\,3}}{4} \times \frac{5}{\cancel{3}_{\,1}} = \frac{15}{4} = \underline{\ ?\ }$$

Divide and check:

	a	*b*	*c*
4.	$4\frac{2}{3} \div \frac{2}{3}$	$5\frac{2}{5} \div \frac{3}{5}$	$7\frac{1}{2} \div \frac{3}{4}$
5.	$2\frac{1}{4} \div \frac{3}{4}$	$6\frac{3}{5} \div \frac{3}{4}$	$3\frac{3}{10} \div \frac{4}{5}$
6.	$2\frac{1}{5} \div \frac{3}{5}$	$8\frac{1}{2} \div \frac{2}{3}$	$6\frac{1}{4} \div \frac{3}{10}$
7.	$8\frac{1}{3} \div \frac{5}{6}$	$4\frac{1}{6} \div \frac{2}{3}$	$5\frac{1}{4} \div \frac{3}{16}$
8.	$9\frac{1}{2} \div \frac{5}{6}$	$3\frac{1}{8} \div \frac{5}{12}$	$8\frac{2}{5} \div \frac{7}{10}$

9. How many times is $\frac{5}{12}$ contained in $6\frac{1}{4}$?

10. Draw a line $2\frac{1}{4}$ in. long. Divide it into sections each $\frac{3}{4}$ in. long.

How many sections are there?

11. Write a division to show what you did in Ex. 10.

Dividing mixed numbers by whole numbers

1. The 6 girls in a cooking class made $4\frac{1}{2}$ lb. of candied popcorn. They want to divide it equally.

Do you know how much each girl should take?

① Louise said, "We should each take $\frac{1}{6}$ of the $4\frac{1}{2}$ lb." She wrote:

$$\boxed{\frac{1}{6} \text{ of } 4\frac{1}{2} = \frac{1}{\cancel{6}_{2}} \times \frac{\cancel{9}^{3}}{2} = \frac{3}{4}}$$

Her work shows that each girl should take _?_ lb.

② Molly said, "We have $4\frac{1}{2}$ lb. to divide among 6 of us. We should find $4\frac{1}{2} \div 6$." She wrote:

$$\boxed{4\frac{1}{2} \div 6 = \frac{9}{2} \div \frac{6}{1} = \frac{\cancel{9}^{3}}{2} \times \frac{1}{\cancel{6}_{2}} = \frac{3}{4}}$$

Do Molly and Louise agree on how much popcorn each girl should take?

2. Jean said, "That's interesting. Louise found $\frac{1}{6}$ of $4\frac{1}{2}$. Molly found $4\frac{1}{2} \div 6$. They both got the same answer."

Does $\frac{1}{6}$ of $12 = 12 \div 6$?
Does $\frac{1}{6}$ of $54 = 54 \div 6$?
Does $\frac{1}{6}$ of $42 = 42 \div 6$?
Then should $\frac{1}{6}$ of $4\frac{1}{2} = 4\frac{1}{2} \div 6$? Why?

3. Show that if each of the 6 girls in Ex. 1 takes $\frac{3}{4}$ pound of popcorn, all the popcorn will be taken.

4. Copy, complete, and check:

$$3\frac{1}{3} \div 5 = \frac{10}{3} \div \frac{5}{1} = \frac{\cancel{10}^{2}}{3} \times \frac{1}{\cancel{5}_{1}} = \underline{\ ?\ }$$

5. Show that $\frac{1}{4}$ of $2\frac{2}{3} = 2\frac{2}{3} \div 4$

Divide. Check by multiplying.

	a	*b*	*c*
6.	$2\frac{1}{4} \div 3$	$16\frac{1}{2} \div 9$	$8\frac{2}{3} \div 2$
7.	$5\frac{2}{5} \div 2$	$18\frac{3}{4} \div 5$	$6\frac{1}{3} \div 2$
8.	$9\frac{1}{3} \div 12$	$10\frac{5}{8} \div 5$	$6\frac{3}{5} \div 3$
9.	$6\frac{2}{3} \div 10$	$25\frac{2}{3} \div 7$	$6\frac{1}{8} \div 7$

Without doing each division, choose the sensible answer:

10. Does $12\frac{1}{2} \div 5 = \frac{2}{5}$ or $2\frac{1}{2}$?

11. Does $3\frac{1}{3} \div 5 = \frac{2}{3}$ or 3?

12. Does $1\frac{1}{2} \div 6 = 4$ or $\frac{1}{4}$?

13. Nine girls in a cooking class share the $2\frac{1}{4}$ lb. of potato chips they made.

What part of a pound does each girl get?

14. If you divide a $9\frac{1}{2}$-ft. pole into 4 equal pieces, how long will each piece be?

Dividing a fraction by a mixed number

1. Bill had a quart can $\frac{3}{4}$ full of paint. With it he was able to paint 2 whole shutters and $\frac{1}{4}$ of another.

He said, "To find how much paint I use on one shutter, I'll divide $\frac{3}{4}$ qt. by $2\frac{1}{4}$."

Explain Bill's division below.

$$\boxed{\frac{3}{4} \div 2\frac{1}{4} = \frac{3}{4} \div \frac{9}{4} = \frac{\overset{1}{\cancel{3}}}{\underset{1}{\cancel{4}}} \times \frac{\overset{1}{\cancel{4}}}{\underset{3}{\cancel{9}}} = \frac{1}{3}}$$

The division shows that Bill needed $\frac{1}{3}$ qt. of paint for each shutter.

2. To check the work in Ex. 1, think, "If Bill used $\frac{1}{3}$ qt. of paint on one shutter, then on $2\frac{1}{4}$ shutters he used $2\frac{1}{4} \times \frac{1}{3}$ qt. Is that $\frac{3}{4}$ qt.?"

$$2\frac{1}{4} \times \frac{1}{3} = \frac{\overset{3}{\cancel{9}}}{4} \times \frac{1}{\underset{1}{\cancel{3}}} = \underline{\ ?\ }$$

3. If Bill uses $\frac{1}{3}$ qt. of paint for 1 shutter, how much paint should he buy for the $3\frac{3}{4}$ shutters that remain to be painted?

4. During a rainstorm, $\frac{3}{4}$ in. of rain fell in $2\frac{1}{3}$ hr. How much rain fell in 1 hr. on the average?

5. A rainfall of $\frac{9}{10}$ in. in $2\frac{1}{4}$ hr. is an average of _?_ in. an hour.

Divide. Check by multiplying.

	a	*b*	*c*
6.	$\frac{3}{4} \div 3\frac{3}{5}$	$\frac{5}{6} \div 2\frac{2}{3}$	$\frac{2}{5} \div 1\frac{3}{5}$
7.	$\frac{3}{4} \div 4\frac{1}{2}$	$\frac{9}{16} \div 4\frac{1}{2}$	$\frac{1}{6} \div 2\frac{1}{3}$
8.	$\frac{2}{3} \div 3\frac{1}{3}$	$\frac{5}{6} \div 3\frac{3}{4}$	$\frac{3}{5} \div 4\frac{1}{2}$
9.	$\frac{5}{8} \div 1\frac{1}{4}$	$\frac{9}{10} \div 1\frac{4}{5}$	$\frac{1}{2} \div 2\frac{1}{2}$
10.	$\frac{3}{8} \div 2\frac{1}{4}$	$\frac{3}{10} \div 1\frac{1}{3}$	$\frac{5}{8} \div 1\frac{2}{3}$

11. Nan is knitting a belt. She has knitted $\frac{3}{4}$ yd. in $4\frac{1}{2}$ hr., or an average of _?_ yd. an hour.

12. Grace made 6 yd. of braided rope for a rug in $4\frac{1}{2}$ hr. That was an average of _?_ yd. an hour.

13. Patty braided $12\frac{1}{2}$ yd. of rope for a rug in 5 hr. She said she averaged $2\frac{1}{2}$ yd. an hour. Is she right?

14. George is studying a map on which $\frac{1}{8}$ in. represents 50 mi. How long a distance does a line 2 in. long represent on that map?

15. Barbara has gained $\frac{3}{4}$ lb. in 4 days. She has gained _?_ lb. each day on the average.

16. Richard has gained $\frac{7}{8}$ lb. in 4 days. He has gained _?_ lb. a day on the average.

Dividing mixed numbers by mixed numbers

The boys in the Nature Club bought $12\frac{1}{2}$ pounds of suet to feed the birds. If they cut the suet into $1\frac{1}{4}$-pound pieces, how many pieces will they have?

Roger said, "We must find how many times $1\frac{1}{4}$ is contained in $12\frac{1}{2}$. We must divide $12\frac{1}{2}$ by $1\frac{1}{4}$." Was he right?

Roger changed each mixed number to an improper fraction. He did this figuring:

$$\boxed{12\frac{1}{2} \div 1\frac{1}{4} = \frac{25}{2} \div \frac{5}{4} = \frac{\overset{5}{\cancel{25}}}{\underset{1}{\cancel{2}}} \times \frac{\overset{2}{\cancel{4}}}{\underset{1}{\cancel{5}}} = 10}$$

Roger found they would have 10 pieces of suet. He checked his work by thinking, "Does 10 times $1\frac{1}{4}$ lb. equal $12\frac{1}{2}$ lb.?"

1. How many $2\frac{1}{4}$-pound packages of nails can be made up from a $31\frac{1}{2}$-pound keg of nails?

There is one error *in these divisions. Find it and then do the division correctly.*

2. $2\frac{3}{5} \div 1\frac{1}{5} = \frac{13}{5} \div \frac{6}{5} = \frac{13}{\underset{1}{\cancel{5}}} \times \frac{\overset{1}{\cancel{5}}}{6} = \frac{13}{6} = 2\frac{1}{6}$

3. $4\frac{1}{2} \div 1\frac{1}{4} = \frac{9}{2} \div \frac{5}{4} = \frac{9}{\underset{1}{\cancel{2}}} \times \frac{\overset{2}{\cancel{4}}}{5} = \frac{18}{5} = 3\frac{3}{4}$

Divide. Check by multiplying.

	a	*b*	*c*
4.	$9\frac{1}{2} \div 1\frac{1}{3}$	$8\frac{1}{3} \div 6\frac{2}{3}$	$2\frac{3}{4} \div 2\frac{1}{5}$
5.	$2\frac{2}{3} \div 1\frac{1}{6}$	$3\frac{3}{5} \div 1\frac{1}{2}$	$8\frac{3}{4} \div 2\frac{1}{3}$
6.	$8\frac{1}{2} \div 2\frac{1}{2}$	$5\frac{2}{5} \div 1\frac{1}{3}$	$7\frac{1}{5} \div 2\frac{3}{5}$
7.	$3\frac{1}{2} \div 1\frac{1}{4}$	$7\frac{1}{2} \div 1\frac{2}{3}$	$6\frac{3}{5} \div 2\frac{2}{3}$
8.	$8\frac{1}{3} \div 2\frac{1}{2}$	$6\frac{1}{4} \div 2\frac{1}{2}$	$5\frac{1}{2} \div 1\frac{1}{4}$
9.	$7\frac{1}{2} \div 3\frac{1}{3}$	$8\frac{2}{5} \div 3\frac{1}{2}$	$7\frac{1}{2} \div 1\frac{3}{5}$

Tell which statements are true and which are false:

10. $\frac{1}{2}$ of $4 = 4 \times \frac{1}{2}$ $\qquad$ $\frac{1}{2}$ of $4 = 4 \div 2$

11. $8 \div \frac{1}{2} = \frac{1}{2}$ of 8 $\qquad$ $8 \div 2 = \frac{1}{2} \times 8$

12. $8 \div \frac{1}{2} = 8 \div 2$ $\qquad$ $\frac{1}{4}$ of $8 = 8 \div 4$

13. $\frac{1}{2}$ of $6 = 6 \div 2$ $\qquad$ $6 \div \frac{1}{2} = \frac{1}{2}$ of 6

Use a ruler to find the answers to these examples:

14. How many $\frac{1}{4}$'s are there in $\frac{3}{4}$?
$\frac{3}{4} \div \frac{1}{4} = \underline{\ ?\ }$

15. How many $\frac{1}{8}$'s are there in $\frac{1}{4}$? in $\frac{3}{4}$? $\frac{3}{4} \div \frac{1}{8} = \underline{\ ?\ }$

16. $\frac{1}{8} + \frac{1}{8} = \frac{?}{8} = \frac{?}{4}$; $2 \times \frac{1}{8} = \frac{?}{8} = \frac{?}{4}$

17. $\frac{1}{4} + \frac{1}{4} = \frac{?}{4} = \frac{1}{?}$; $\frac{1}{2}$ of $\frac{1}{2} = \underline{\ ?\ }$
$\frac{1}{2} \div 2 = \frac{?}{?}$; $\frac{1}{4}$ is what part of $\frac{1}{2}$?

18. $\frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = \frac{?}{8} = \frac{1}{?}$
$\frac{1}{4}$ of $\frac{1}{2} = \frac{?}{?}$; $\frac{1}{2} \div 4 = \frac{?}{?}$

Multiplying and dividing fractions

1. When you do the multiplication in the box at the right, think:

$\boxed{\frac{1}{4} \times \frac{3}{4}}$

$1 \times 3 = \underline{?}$; $4 \times 4 = \underline{?}$.

The answer is a fraction whose numerator is $\underline{?}$ and whose denominator is $\underline{?}$.

2. After the first step in this example has been done, it looks like this: ⟶

$\boxed{1\frac{1}{2} \times \frac{3}{4}}$
$\boxed{\frac{3}{2} \times \frac{3}{4}}$

Is it now the same kind of example as in Ex. 1? What was done to make it look like the example in Ex. 1? Finish the example.

3. Jack and Dick did the example at the right in these two ways:

$\boxed{\frac{3}{4} \times \frac{5}{6}}$

JACK

$$\frac{3}{4} \times \frac{5}{6} = \frac{15}{24} = \frac{5}{8}$$

DICK

$$\frac{\overset{1}{\cancel{3}}}{4} \times \frac{5}{\underset{2}{\cancel{6}}} = \frac{5}{8}$$

How does their work differ? Did they get the same answer?

4. Draw 3 large circles of the same size. Divide the circles into fourths. Use the circles to prove that $3 \div \frac{3}{4} = 4$.

5. How many groups of 3 pencils are there in 19 pencils?

How many 3 *fourths* are there in 19 *fourths?* $\frac{19}{4} \div \frac{3}{4} = \underline{?}$

6. After the first step in this example has been done, it looks like this: ⟶ Find the answer.

$\boxed{\frac{3}{4} \div \frac{2}{3}}$
$\boxed{\frac{3}{4} \times \frac{3}{2}}$

7. After the first two steps in this example have been done, it looks like this: ⟶ Find the answer.

$\boxed{3\frac{1}{3} \div \frac{2}{5}}$
$\boxed{\frac{10}{3} \times \frac{5}{2}}$

8. How many different methods can you use to find the answer to the example $2\frac{1}{4} \div \frac{1}{4}$?

Use a ruler to find the answers to Exs. 9–17:

9. $\frac{3}{8}+\frac{3}{8}=\frac{?}{8}$; $\frac{1}{2}$ of $\frac{6}{8}=\frac{?}{8}$; $\frac{6}{8}\div 2=\frac{?}{?}$.

10. $\frac{3}{4}$ is $\underline{?}$ times $\frac{3}{8}$; $\frac{3}{4} \div \frac{3}{8} = \underline{?}$.

11. $1\frac{1}{4}$ is $\underline{?}$ times $\frac{1}{4}$; $1\frac{1}{4} \div \frac{1}{4} = \underline{?}$.

12. $3\frac{1}{2}$ is $\underline{?}$ times $\frac{1}{2}$; $3\frac{1}{2} \div \frac{1}{2} = \underline{?}$.

13. 4 is $\underline{?}$ times 2; 4 is $\underline{?}$ times $\frac{1}{2}$;
$4 \div 2 = \underline{?}$; $4 \div \frac{1}{2} = \underline{?}$

14. $\frac{5}{8} + \frac{5}{8} = \frac{?}{8} = 1\frac{?}{8} = 1\frac{?}{4}$
$2 \times \frac{5}{8} = \frac{?}{8} = 1\frac{?}{8} = 1\frac{?}{4}$

15. Find:
$\frac{1}{2}$ of 2; $\frac{1}{2}$ of $\frac{1}{2}$; $\frac{1}{2}$ of $2\frac{1}{2}$; $2\frac{1}{2} \div 2$.

16. $\frac{1}{2}$ of $\frac{6}{8} = \frac{6}{8} \div \underline{?}$.

17. Find:
$\frac{1}{4}$ of 8; $\frac{1}{4}$ of $\frac{1}{2}$; $\frac{1}{4}$ of $8\frac{1}{2}$; $8\frac{1}{2} \div 4$.

Review of division

1. Does $12 \div 4 = 12 \times \frac{1}{4}$?

2. Does $12 \div 3 = 12 \times \frac{1}{3}$?

3. Does $12 \div 6 = 12 \times \frac{1}{6}$?

4. Does $\frac{20}{4} = 20 \times \frac{1}{4}$?

5. Does $\frac{20}{5} = 20 \times \frac{1}{5}$?

6. Does $\frac{20}{10} = 20 \times \frac{1}{10}$?

7. Does $8 \div \frac{1}{2} = 8 \times \frac{2}{1}$?

8. Does $6 \div \frac{1}{3} = 6 \times \frac{3}{1}$?

9. Does $2\frac{1}{2} \div \frac{1}{2} = 2\frac{1}{2} \times \frac{2}{1}$?

10. Does $10 \div \frac{5}{2} = 10 \times \frac{2}{5}$?

11. Does $20 \div 2\frac{1}{2} = 20 \times \frac{2}{5}$?

12. Joe made this rule for division. Show that it works for whole numbers, fractions, and mixed numbers.

> **Dividend $\div$ divisor = dividend $\times$ the inverted divisor.**

Show how Joe's rule works in these examples:

	a	*b*	*c*
13.	$8 \div 4$	$4 \div 8$	$2\frac{1}{2} \div \frac{1}{2}$
14.	$6 \div 2\frac{1}{2}$	$\frac{3}{4} \div \frac{2}{3}$	$\frac{1}{2} \div 2\frac{1}{2}$
15.	$\frac{2}{3} \div \frac{3}{4}$	$\frac{3}{5} \div \frac{4}{5}$	$2\frac{1}{2} \div 6$
16.	$\frac{1}{2} \div 1\frac{1}{2}$	$\frac{4}{5} \div \frac{3}{5}$	$1\frac{1}{2} \div \frac{1}{2}$
17.	$\frac{1}{8} \div 2$	$\frac{3}{4} \div 2$	$1\frac{1}{2} \div 2$

There are three mistakes *in Exs. 18–24. Can you find them?*

18. $24 \div 36 = \overset{2}{\cancel{24}} \times \frac{1}{\underset{3}{\cancel{36}}} = \frac{2}{3}$

19. $36 \div 24 = \overset{3}{\cancel{36}} \times \frac{1}{\underset{2}{\cancel{24}}} = \frac{3}{2} = 1\frac{1}{2}$

20. $3\frac{3}{4} \div \frac{3}{4} = \frac{\overset{5}{\cancel{15}}}{\underset{1}{\cancel{4}}} \times \frac{\overset{1}{\cancel{4}}}{\underset{1}{\cancel{3}}} = 5$

21. $22\frac{3}{8} \div 3\frac{1}{2} = \frac{179}{\underset{4}{\cancel{8}}} \times \frac{\overset{1}{\cancel{2}}}{7} = \frac{179}{28} = 6\frac{13}{28}$

22. The quotient of the example $20 \div \frac{3}{5}$ is more than 40.

23. The quotient of the example $18\frac{1}{2} \div 3$ is $6\frac{1}{6}$.

24. The quotient of the example $10 \div 2\frac{5}{8}$ is larger than the quotient of $10 \div 2\frac{1}{2}$.

Are these statements true *or* false?

25. $\frac{1}{3} \div 4 = \frac{1}{12}$; so
$\frac{2}{3} \div 4 = 2 \times \frac{1}{12}$

26. $\frac{1}{3}$ of $\frac{1}{4}$ is $\frac{1}{12}$; so
$\frac{1}{3}$ of $\frac{2}{4}$ is $\frac{1}{12} + \frac{1}{12}$

27. $\frac{1}{3}$ of $\frac{4}{5}$ is $\frac{4}{15}$; so
$\frac{2}{3}$ of $\frac{4}{5}$ is $2 \times \frac{4}{15}$

28. $\frac{3}{4} \div \frac{1}{5}$ is $\frac{15}{4}$; so
$\frac{3}{4} \div \frac{2}{5}$ is $\frac{1}{2}$ of $\frac{15}{4}$, or $\frac{15}{8}$

Division with fractions and mixed numbers

	EXAMPLE	CHANGE MIXED NUMBER TO IMPROPER FRACTION. ALSO WRITE WHOLE NUMBERS OVER 1	INVERT DIVISOR AND CHANGE ÷ TO ×	MULTIPLY AND REDUCE TO SIMPLEST FORM	PAGE WHERE TAUGHT
A	$7 \div \frac{2}{3}$	$= \frac{7}{1} \div \frac{2}{3}$	$= \frac{7}{1} \times \frac{3}{2}$	$= \frac{21}{2} = 10\frac{1}{2}$	131
B	$6 \div 1\frac{1}{4}$	$= \frac{6}{1} \div \frac{5}{4}$	$= \frac{6}{1} \times \frac{4}{5}$	$= \frac{24}{5} = 4\frac{4}{5}$	133
C	$\frac{3}{4} \div \frac{2}{3}$		$= \frac{3}{4} \times \frac{3}{2}$	$= \frac{9}{8} = 1\frac{1}{8}$	136
D	$\frac{3}{4} \div 2$	$= \frac{3}{4} \div \frac{2}{1}$	$= \frac{3}{4} \times \frac{1}{2}$	$= \frac{3}{8}$	137
E	$2\frac{1}{4} \div \frac{2}{3}$	$= \frac{9}{4} \div \frac{2}{3}$	$= \frac{9}{4} \times \frac{3}{2}$	$= \frac{27}{8} = 3\frac{3}{8}$	140
F	$3\frac{2}{3} \div 4$	$= \frac{11}{3} \div \frac{4}{1}$	$= \frac{11}{3} \times \frac{1}{4}$	$= \frac{11}{12}$	141
G	$\frac{1}{4} \div 1\frac{1}{3}$	$= \frac{1}{4} \div \frac{4}{3}$	$= \frac{1}{4} \times \frac{3}{4}$	$= \frac{3}{16}$	142
H	$5\frac{1}{2} \div 1\frac{1}{3}$	$= \frac{11}{2} \div \frac{4}{3}$	$= \frac{11}{2} \times \frac{3}{4}$	$= \frac{33}{8} = 4\frac{1}{8}$	143

Above is a table that shows the kinds of division you have learned to do with fractions. There are eight kinds of examples. Explain how each kind is done.

In Example A the 131 in the last column tells that this kind of example is taught on page 131.

1. Example A illustrates how to divide a _?_ number by a _?_. Tell what kind of division B illustrates; C; D; E; F; G; H.

2. Jane said, "Example H shows how to do any of the others. If I can do that kind, I can do any kind." Do you agree?

3. Leo said, "Jane is right. You just change the dividend and the divisor to fractions; then invert the divisor and multiply. That's what was done in Example H and in each of the others."

Was Leo right? Are all the examples really done the same way?

Review practice

1.
$$\begin{array}{r} \$\ 36 \\ 68 \\ 255 \\ 76 \\ \underline{798} \end{array}$$

2.
$$\begin{array}{r} \$4.28 \\ 9.78 \\ 8.89 \\ 7.67 \\ \underline{7.96} \end{array}$$

3.
$$\begin{array}{r} 6040 \\ \underline{-\ 3842} \end{array}$$

4.
$$\begin{array}{r} \$94.75 \\ \underline{-\ 13.89} \end{array}$$

5.
$$\begin{array}{r} 675 \\ \underline{\times\ 800} \end{array}$$

6.
$$\begin{array}{r} \$5.86 \\ \underline{\times\ 70} \end{array}$$

7. Divide 18,022 by 88; by 78.

8. Divide 20,390 by 75; by 65.

9. Add $6\frac{3}{8}$, $\frac{7}{16}$, $8\frac{1}{2}$, and $8\frac{3}{4}$.

10. From 30 take $22\frac{5}{8}$; take $8\frac{2}{3}$.

11. Copy and complete the following:

26 pk. = _?_ bu., _?_ pk.
22 mo. = _?_ yr., _?_ mo.
26 oz. = _?_ lb., _?_ oz.
75 in. = _?_ yd., _?_ in.

12. Multiply $4\frac{1}{2}$ by $2\frac{1}{4}$.

13. Multiply 16 by $5\frac{5}{8}$.

14. How many ounces of grass seed at 80¢ a pound can you buy for 60¢?

15. John is planning to whiten the ceiling of the basement playroom, which is 16′ long and 12′ wide. One can of powder will make enough whitening to cover 200 sq. ft.

How many cans of powder does John need?

16. Joan shared a piece of ribbon $1\frac{3}{4}$ yd. long with her sister. Each then had _?_ yd. of ribbon.

17. If you walk 4 times around a block 680′ long and 650′ wide, will you walk more than 2 miles? (2 mi. = _?_ ft.)

18. Patty weighs $72\frac{1}{4}$ lb. Rena weighs $67\frac{3}{4}$ lb. Patty weighs _?_ lb. more than Rena.

19. Draw a line $3\frac{1}{2}$ in. long. Divide it into sections $\frac{1}{2}$ in. long. How many of these sections are there in the line?

20. Write a division to show what you did in Ex. 19.

21. At a carnival, fudge sold at 80¢ a pound. Fred asked to buy all that was left in the pan.

Mary found that the fudge that was left weighed 3 oz. How much should Fred have paid for it?

22. At 80¢ a pound, find the cost of 5 oz. of fudge; of 6 oz.; 7 oz.; 8 oz.; 10 oz.; 12 oz.

Finding errors

Can you find **9** *wrong answers* on Vernon's test paper? (Answers not in simplest form are to be called wrong.) On your paper do correctly the examples Vernon had wrong.

Vernon Reilly December 18

(1) $\frac{3}{\underset{1}{\cancel{4}}} \times \frac{\overset{1}{\cancel{4}}}{5} = \frac{3}{5}$

(2) $1\frac{4}{5} \times \frac{5}{6} = \frac{\overset{3}{\cancel{9}}}{\underset{1}{\cancel{5}}} \times \frac{\overset{1}{\cancel{5}}}{\underset{2}{\cancel{6}}} = \frac{3}{2} = 1\frac{1}{3}$

(3) $\frac{8}{9} \times 4 = \frac{32}{9} = 3\frac{5}{9}$

(4) $10 \div \frac{3}{5} = 10 \times \frac{5}{3} = \frac{50}{3} = 17\frac{2}{3}$

(5) $\frac{5}{6} \div \frac{3}{10} = \frac{5}{\underset{3}{\cancel{6}}} \times \frac{\overset{5}{\cancel{10}}}{3} = \frac{25}{9}$

(6) $2 \div \frac{1}{2} = 2 \times \frac{2}{1} = 4$

(7) $\frac{7}{8} \times \frac{2}{3} = \frac{14}{24}$

(8) $\frac{3}{5} \div 12 = \frac{\overset{1}{\cancel{3}}}{5} \times \frac{1}{\underset{4}{\cancel{12}}} = \frac{1}{20}$

(9) $\frac{3}{10} \div \frac{3}{5} = \frac{\overset{1}{\cancel{3}}}{\underset{2}{\cancel{10}}} \times \frac{\overset{1}{\cancel{5}}}{\underset{1}{\cancel{3}}} = 2$

(10) $\frac{7}{8} \div \frac{3}{4} = \frac{7}{\underset{2}{\cancel{8}}} \times \frac{\overset{1}{\cancel{4}}}{3} = \frac{7}{6}$

(11) $9 \times \frac{2}{5} = \frac{18}{5} = 3\frac{3}{5}$

(12) $\frac{5}{6} \times 1\frac{1}{4} = \frac{5}{6} \times \frac{5}{4} = \frac{25}{24}$

(13) $\frac{5}{8} \div \frac{5}{8} = \frac{\overset{1}{\cancel{5}}}{\underset{1}{\cancel{8}}} \times \frac{\overset{1}{\cancel{8}}}{\underset{1}{\cancel{5}}} = 0$

(14) $\frac{\overset{1}{\cancel{2}}}{\underset{1}{\cancel{3}}} \times \frac{\overset{1}{\cancel{3}}}{\underset{2}{\cancel{4}}} = \frac{1}{2}$

(15) $1\frac{2}{5} \div \frac{3}{10} = \frac{7}{5} \div \frac{3}{10} = \frac{7}{\underset{1}{\cancel{5}}} \times \frac{\overset{2}{\cancel{10}}}{3} = \frac{14}{3} = 4\frac{2}{3}$

(16) $4\frac{1}{2} \div 1\frac{1}{3} = \frac{9}{2} \div \frac{4}{3} = \frac{9}{2} \times \frac{3}{4} = \frac{27}{8} = 3\frac{3}{5}$

Using fractions

1. The sixth-grade girls are filling paper bags with candy for a school carnival. Small bags are to be filled with $\frac{1}{8}$ lb. of candy.

How many small bags can they fill from each of these amounts?

$\frac{3}{4}$ lb. sea foam	$\frac{1}{2}$ lb. raisin bars
$1\frac{1}{2}$ lb. caramels	1 lb. nut brittle

2. How much will the girls take in by selling all the small bags of candy at 5¢? (Save your answer.)

3. At the rate of $\frac{1}{8}$ lb. for 5¢, how much candy should they put in a 10-cent bag?

4. How many medium-sized $\frac{1}{4}$-lb. bags can be filled from each of these amounts?

$\frac{3}{4}$ lb. nut crisp	$1\frac{1}{2}$ lb. nut patties
1 lb. mints	3 lb. taffy

5. At 10¢ a bag, how much will the girls take in if they sell all the bags in Ex. 4? (Save your answer.)

6. At the rate of $\frac{1}{8}$ lb. for 5¢, how much candy should be put in a 15-cent bag?

7. How many large 15-cent bags can be filled from each of these amounts?

$1\frac{1}{8}$ lb. creams	$\frac{3}{4}$ lb. fudge
3 lb. wafers	$1\frac{7}{8}$ lb. nut brittle

8. At 15¢ a bag, how much will the girls take in if they sell all the large bags they have filled?

9. How much will they take in on the 5-cent, 10-cent, and 15-cent bags all together?

10. The girls weigh the candy on balance scales. They have 1-ounce, 2-ounce, 4-ounce, and 8-ounce weights.

Tell which weights they use to weigh the candy for the 5-cent, 10-cent, and 15-cent bags.

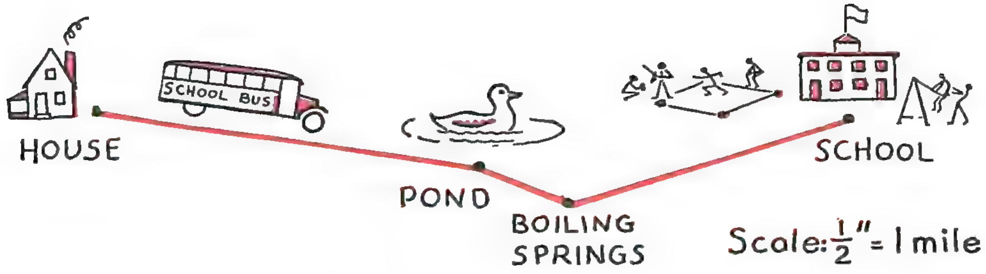
11. At the carnival small spice cakes will sell at 25¢ each. How much should Ellen pay for $2\frac{1}{2}$ cakes?

12. One bag of popcorn weighs $1\frac{1}{4}$ lb. How much does half a bagful weigh? two bagsful? three bagsful?

13. How much should Janet charge for a $2\frac{3}{8}$-lb. box of maple sugar candy at 80¢ a pound?

14. Three large cakes were each cut into 16 equal servings. If Jane buys $\frac{1}{2}$ of one cake and Marie buys $\frac{1}{4}$ of one cake, how many servings will each girl buy?

How many servings will be left in all three cakes together?



Using a scale drawing

Ted made the above drawing of the trip he takes on the school bus. His drawing is called a ***scale drawing***. Each $\frac{1}{2}$ inch on the drawing stands for 1 mile. The ***scale*** is $\frac{1}{2}$ inch to 1 mile.

1. Where is the scale shown on Ted's drawing?

2. If $\frac{1}{2}$ in. represents 1 mile, what does 1 in. represent? $1\frac{1}{2}$ in.? 2 in.? $2\frac{1}{2}$ in.? 3 in.?

3. Find the length of the line between Ted's house and the skating pond. How many miles does this line represent?

4. How many miles is it from the pond to Boiling Springs? from Boiling Springs to the school?

5. How long is Ted's bus trip to school each day?

6. Using the scale $\frac{1}{2}$ in. to 1 mi., draw a line to represent 1 mi.; 2 mi.; 3 mi.; 4 mi.; 5 mi.

7. Using the scale $\frac{1}{4}$ in. to 1 mi., draw a line representing 1 mi.; 2 mi.; 3 mi.; 4 mi.; 8 mi.; 9 mi.;

8. Where have you seen scale drawings used? Tell about those you have seen.

Copy these tables. Fill in the missing numbers.

9. TABLE SHOWING DISTANCES ON A SCALE OF $\frac{1}{2}$ IN. TO 1 FT.

INCHES ON DRAWING	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	?	?	?	?	$4\frac{1}{2}$	?	?	6
DISTANCE IN FEET	1	2	?	?	?	6	?	?	?	10	?	?

10. TABLE SHOWING DISTANCES ON A SCALE OF $\frac{1}{4}$ IN. TO 1 FT.

INCHES ON DRAWING	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	?	?	?	$1\frac{3}{4}$	?	?	$2\frac{1}{2}$	?	3
DISTANCE IN FEET	1	2	?	?	5	?	?	?	9	?	?	12

Practice with measures

Jean said, "When I see *pints* and *quarts*, I think *2*. I think this because there are _?_ pt. in 1 qt."

She also said, "When I see *minutes* and *hours*, I think *60*, because there are _?_ min. in 1 hr."

Tell what number you think of for each of these pairs of measures:

	a	b	c	d	e
1.	qt., gal.	in., ft.	sec., min.	qt., pk.	dime, dollar
2.	in., yd.	mo., yr.	oz., lb.	min., hr.	ft., yd.
3.	pk., bu.	ft., mi.	da., wk.	lb., ton	things, doz.

Complete these statements:

	a	b	c
4.	4 lb. = _?_ oz.	4 bu. = _?_ pk.	6 ft. = _?_ in.
5.	2 hr. = _?_ min.	5 yd. = _?_ ft.	5 pk. = _?_ qt.
6.	3 yr. = _?_ mo.	2 tons = _?_ lb.	5 gal. = _?_ qt.
7.	$\frac{1}{4}$ hr. = _?_ min.	$\frac{1}{2}$ min. = _?_ sec.	$\frac{1}{2}$ mi. = _?_ ft.
8.	1 mi. = _?_ yd.	$\frac{1}{4}$ bu. = _?_ pk.	$\frac{1}{4}$ yr. = _?_ mo.
9.	$\frac{3}{4}$ lb. = _?_ oz.	$\frac{2}{3}$ ft. = _?_ in.	$\frac{3}{4}$ yd. = _?_ in.
10.	8 in. = _?_ ft.	20 min. = _?_ hr.	1200 lb. = _?_ ton
11.	24 in. = _?_ yd.	10 oz. = _?_ lb.	2 ft. = _?_ yd.
12.	4 mo. = _?_ yr.	6 qt. = _?_ pk.	2 qt. = _?_ gal.
13.	2 yr. 6 mo. = _?_ mo.	1 yd. 9 in. = _?_ in.	4 lb. 4 oz. = _?_ lb.
14.	3 gal. 2 qt. = _?_ qt.	2 ft. 6 in. = _?_ in.	5 lb. 10 oz. = _?_ lb.
15.	6 bu. 2 pk. = _?_ pk.	8 lb. 5 oz. = _?_ lb.	2 yr. 5 mo. = _?_ yr.
16.	$\frac{1}{4}$ mi. = _?_ yd.	30 mo. = _?_ yr.	9 in. = _?_ ft.

Oral fraction practice

1. To reduce $\frac{12}{16}$ to lowest terms, divide both the numerator and the denominator by _?_.

2. Show that the value of a fraction is not changed by multiplying the numerator and the denominator by the same number.

3. $2 \div \frac{1}{2} =$ _?_ asks the question, "How many _?_'s are there in 2?"

4. $\frac{1}{2}+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}=\frac{4}{2}=2$. This addition shows that in 2 there are _?_ $\frac{1}{2}$'s. Does the addition show that $2 \div \frac{1}{2} = 4$?

5. To add $\frac{3}{10}$ and $\frac{3}{5}$, change the $\frac{3}{5}$ to $\frac{?}{?}$.

6. In subtracting $\frac{2}{5}$ from $\frac{1}{2}$, use _?_ as a common denominator.

7. A common denominator of $\frac{1}{3}$ and $\frac{1}{4}$ is 24, but the smallest common denominator is _?_.

8. To change $\frac{5}{6}$ to a fraction whose denominator is 12, think: A whole $= \frac{12}{12}$; $\frac{1}{6} = \frac{2}{12}$; $\frac{5}{6} = \frac{?}{12}$.

9. To subtract $\frac{4}{5}$ from 3, think of 3 as _?_.

10. To multiply fractions, multiply the _?_ and then multiply the _?_.

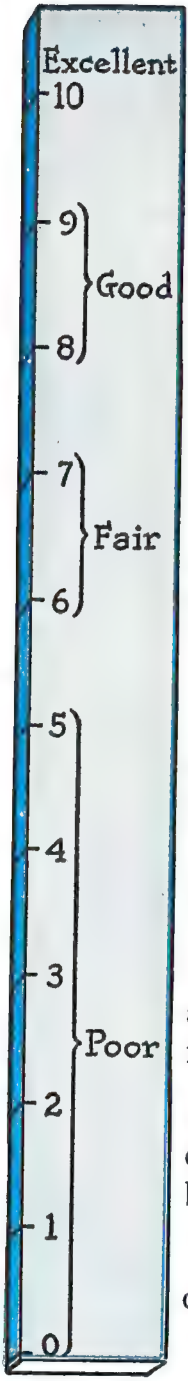
11. To divide 8 by $\frac{2}{3}$, invert the $\frac{2}{3}$ and then _?_.

Written fraction practice

	a	*b*	*c*	*d*	*e*	*f*
1.	$\frac{5}{12} + \frac{5}{12}$	$\frac{5}{6} + \frac{1}{2}$	$\frac{3}{4} + \frac{1}{6}$	$2\frac{1}{10} + 1\frac{4}{5}$	$4\frac{3}{4} + 6\frac{7}{8}$	$3\frac{1}{2} + 8\frac{3}{5}$
2.	$\frac{5}{6} - \frac{1}{6}$	$\frac{7}{10} - \frac{2}{5}$	$\frac{4}{5} - \frac{1}{2}$	$3\frac{5}{8} - \frac{1}{4}$	$6 - 1\frac{2}{3}$	$5\frac{1}{4} - 2\frac{7}{8}$

	a	*b*	*c*	*d*	*e*
3.	$\frac{5}{8} \times 12$	$10 \div \frac{2}{5}$	$3\frac{1}{3} \times \frac{3}{4}$	$\frac{3}{5} \times 3\frac{1}{2}$	$\frac{5}{6} \div 10$
4.	$9 \div 2\frac{1}{4}$	$2\frac{2}{3} \times 12$	$\frac{4}{5} \times \frac{5}{8}$	$5 \times \frac{3}{4}$	$6\frac{2}{3} \div 4$
5.	$6 \times 1\frac{1}{3}$	$4\frac{1}{2} \times 3\frac{1}{2}$	$\frac{5}{12} \div \frac{2}{3}$	$5 \div 1\frac{1}{4}$	$\frac{4}{5} \div 1\frac{1}{5}$

Problem Test 3



Measure your growth in problem solving.

1. Ted's father is buying a television set that costs \$225. So far he has paid \$150. If he pays for the rest at the rate of \$15 a month, how long will it take him to pay for the set?

2. George makes garden figures out of wood. How many ducks $1\frac{1}{3}$ ft. high can he cut from a board $10\frac{2}{3}$ ft. long?

3. Bob is making cereal. He read aloud from the box, "Bring 6 cups of water to a boil. Stir in $\frac{3}{4}$ cup cereal. Cook 8 min. Serves 6."

How much water and cereal should he use for 2 servings?

4. A group of Camp Fire Girls walked $1\frac{3}{4}$ mi. to Pirate's Cave and then $1\frac{1}{8}$ mi. farther to Crystal Pond. They walked $2\frac{1}{2}$ mi. back home. They walked _?_ mi. in all.

5. Find the cost of $12\frac{3}{4}$ T. of sand at \$4.60 a ton.

6. It takes 5,600 gal. of furnace oil to heat the Thomas Edison school each year. How much does the oil cost at $9\frac{1}{2}$¢ a gallon?

7. Grace bought a 5-pound bag of sugar. If she uses $2\frac{3}{4}$ lb. for jelly, how much sugar will be left?

8. For a puppet show a sixth-grade class sold 268 tickets at 25¢ each and 96 tickets at 10¢ each. The class also took in \$18.50 at the door. What was the total amount received?

9. How much would you have to pay for 1 bunch of carrots, selling at 2 bunches for 17¢, and 1 can of baked beans, selling at 3 cans for a quarter?

10. How much more would eight 39-cent paint brushes cost than eight 29-cent brushes?

Record your score on your Problem Test Record.

Problems and practice

1. Ann's pudding recipe says "Use $\frac{3}{4}$ cup of liquid, half evaporated milk and half water."

How much milk should Ann use? How much water?

2. Ann's measuring cup is marked into halves, thirds, and fourths. How can she measure $\frac{1}{8}$ of a cup? $\frac{3}{8}$ of a cup?

3. Peter's whitewash formula makes enough whitewash to cover 200 sq. ft. of wall space.

To whitewash 500 sq. ft. of wall space, Peter will have to mix _?_ times his formula.

4. If Peter's whitewash formula calls for $2\frac{1}{2}$ qt. of lime, how much lime should he use if he wants to make $2\frac{1}{2}$ times as much whitewash as the formula makes?

5. Joe is going to make checkers out of a broom handle. Each checker is a disk $\frac{1}{4}''$ thick.

How many inches of broom handle will Joe need to make a set of 24 checkers?

6. Joe (Ex. 5) has a broom handle 40 inches long. Can you find how many checker sets he can cut from it?

Watch the signs!

	a	*b*	*c*	*d*	*e*
7.	$\frac{3}{4} \times \frac{4}{5}$	$4\frac{1}{2} \div 3$	$\frac{3}{4} \div 4$	$16 \div \frac{2}{3}$	$12 \times \frac{5}{16}$
8.	$\frac{3}{8} \times \frac{2}{3}$	$\frac{7}{12} \div \frac{5}{8}$	$\frac{3}{4} \div \frac{6}{8}$	$2\frac{1}{4} \times \frac{2}{3}$	$12 \div 1\frac{1}{5}$
9.	$\frac{4}{5} \div \frac{2}{3}$	$3\frac{1}{3} \div 8$	$6 \div \frac{3}{8}$	$4\frac{1}{2} \times 2\frac{1}{4}$	$3\frac{1}{4} \times \frac{3}{4}$
10.	$\frac{4}{5} \times \frac{3}{4}$	$1\frac{1}{4} \div 5$	$5 \div \frac{1}{2}$	$3\frac{2}{3} \div \frac{2}{5}$	$3\frac{1}{3} \div \frac{1}{6}$
11.	$\frac{5}{8} \div \frac{1}{4}$	$1\frac{1}{4} \times 5$	$\frac{1}{2} \div 5$	$1\frac{3}{4} \times \frac{4}{5}$	$\frac{9}{10} \div \frac{2}{5}$
12.	$5 \times \frac{3}{8}$	$3\frac{3}{8} \times 8$	$\frac{5}{6} \div \frac{1}{2}$	$3\frac{2}{3} \times \frac{3}{8}$	$1\frac{1}{3} \div 1\frac{1}{3}$
13.	$\frac{4}{5} \times 4$	$12 \times 2\frac{5}{6}$	$8 \div \frac{1}{4}$	$8 \div 1\frac{1}{3}$	$10 \div \frac{1}{4}$
14.	$6 \div \frac{3}{5}$	$12 \div 4\frac{1}{2}$	$8 \times \frac{1}{4}$	$10 \div \frac{3}{5}$	$10 \times \frac{1}{4}$
15.	$\frac{3}{5} \times 8$	$2\frac{2}{3} \times 1\frac{1}{2}$	$\frac{4}{5} \times \frac{3}{8}$	$10 \div 1\frac{3}{5}$	$10 \div 1\frac{1}{4}$
16.	$9 \div \frac{3}{4}$	$1\frac{1}{3} \times \frac{3}{4}$	$\frac{3}{4} \div \frac{5}{6}$	$\frac{5}{6} \div 2\frac{1}{2}$	$2\frac{2}{3} \times \frac{3}{4}$

Self-Help Test 3

1. At 50¢ an hour, how much will Lloyd earn by working 2 hr. and 20 min.? (107)

2. If a map is drawn to a scale of $\frac{1}{2}$ inch to 1 mile, how long a distance is represented by a 2-inch line? (150)

3. A school bought a box containing 1 dozen baseballs for $7.80. How much did each of the baseballs cost? (47–50)

4. Multiply $16\frac{3}{5}$ by 35. (115)

5. Edith needs $1\frac{3}{4}$ yd. of material for a skirt, and $2\frac{1}{8}$ yd. for a jacket. How many yards does she need in all? (68)

6. Round these numbers to the nearest thousand:

   4,187 2,679 8,306 (10)

7. How much will $3\frac{1}{4}$ yd. of tweed cost at $2.50 a yard? (96)

8. Find the area of a cement walk $90' \times 6'$. (122)

9. How many pieces of rope $4\frac{1}{2}$ ft. long can be cut from a piece 18 ft. long? (133)

10. How fast must a bus travel per hour to cover a run of 152 mi. in 4 hr.? (100)

11. How much is left if you take $2\frac{2}{3}$ from 10? (70)

Self-Help Test 4

1. $\frac{3}{10} + \frac{2}{10}$ (65)
2. $\frac{7}{8} + \frac{3}{4}$ (66)
3. $2\frac{5}{8} + \frac{3}{4}$ (68)
4. $\frac{2}{3} + \frac{1}{4}$ (67)
5. $\frac{7}{12} - \frac{1}{2}$ (66)
6. $5 - \frac{2}{3}$ (70)
7. $8 - 1\frac{1}{5}$ (70)
8. $5\frac{1}{2} - \frac{2}{3}$ (72)
9. $10 \times \frac{4}{5}$ (86)
10. $\frac{5}{6} \times \frac{8}{9}$ (90)
11. $\frac{2}{3}$ of 11 (91)
12. $5\frac{1}{8} \times 20$ (95)
13. $20 \times 3\frac{4}{5}$ (115)
14. $\frac{5}{6} \times 2\frac{2}{5}$ (110)
15. $6\frac{1}{4} \times \frac{2}{5}$ (110)
16. $5\frac{3}{5} \times 1\frac{1}{4}$ (111)
17. $9 \div \frac{3}{4}$ (130–131)
18. $8 \div 1\frac{1}{3}$ (133)
19. $\frac{5}{12} \div \frac{3}{4}$ (136)
20. $\frac{3}{8} \div 12$ (137)
21. $12\frac{1}{2} \div 5$ (141)
22. $2\frac{3}{10} \div \frac{2}{5}$ (140)
23. $\frac{5}{6} \div 1\frac{2}{3}$ (142)
24. $6\frac{1}{4} \div 1\frac{1}{4}$ (143)

Measuring your growth in arithmetic

Copy all numbers correctly. Work carefully. Check your answers. Be sure your answers are sensible.

1. $\frac{7}{8} \div \frac{1}{2}$

2. $3\frac{1}{8} \div \frac{5}{12}$

3. $\frac{7}{8} \div 4$

4. $\frac{9}{10} \div 3\frac{1}{2}$

5. Allan walks at the rate of $4\frac{1}{2}$ miles an hour. He says that he can walk from Pleasant Valley to Penbrook, a distance of $7\frac{1}{2}$ miles, in _?_ hr.

6. A cooking class is making candy. The recipe calls for $\frac{2}{3}$ cup of molasses for each batch of candy.

How many batches of candy can the class make if they use all of a quart jug that is full of molasses? (1 qt. = _?_ cups.)

7. How much is $5.00 ÷ $1\frac{2}{3}$?

8. Harry was watching a man cleaning fish in the fish market. The man cleaned one fish in about a minute and a half.

At that rate, how many could he clean in 30 min.?

9. It takes 18 in., or $\frac{1}{2}$ yd., of cellophane to cover a sixth-grade science book.

How many of these science books can the class cover with a strip of cellophane that is $4\frac{1}{2}$ yd. long?

10. How many pints will each boy get if 4 boys share equally the $4\frac{1}{2}$ pt. of hickory nuts they gathered?

Just for fun

Puzzle. Arrange three pennies and three dimes in a row like this: ⟶ (You may use toy money.)

Before

Try to rearrange the coins like this in *three moves:* ⟶

After

Each move consists of moving 2 *adjacent* (side by side) coins together, using the first and second fingers.

Each two coins must be together after you move them. There must be no empty spaces in the final row.

Meaning and relationship of tenths, hundredths, thousandths as common fractions and as decimals

UNIT 22

Tenths as decimals

On the drawing of the ruler above, each inch is divided into 10 equal parts.

1. How could you use the ruler to draw a line $\frac{1}{10}$ inch long? $\frac{2}{10}$ inch? $\frac{3}{10}$ inch? $\frac{4}{10}$? $\frac{5}{10}$?

The .5 on the ruler means 5 *tenths* of an inch. The dot before the five is a ***decimal point***. The number .5 is called a ***decimal fraction***. It is equal to the common fraction $\frac{5}{10}$. $.5 = \frac{5}{10}$

The number 1.5 on the ruler is a ***mixed decimal***. The 1 means one whole inch, and the .5 means $\frac{5}{10}$ of an inch.

1.5 is read, "One *and* five tenths." When the decimal point comes between two figures, it is read *and*. $1.5 = 1\frac{5}{10}$

Decimal fractions and mixed decimals are usually referred to as ***decimals***.

$\frac{1}{10} = .1$
$\frac{2}{10} = .2$
$\frac{3}{10} = .3$
$\frac{4}{10} = .4$
$\frac{5}{10} = .5$
$\frac{6}{10} = .6$
$\frac{7}{10} = .7$
$\frac{8}{10} = .8$
$\frac{9}{10} = .9$
$\frac{10}{10} = 1.0$
$1\frac{1}{10} = 1.1$
$1\frac{2}{10} = 1.2$
$1\frac{3}{10} = 1.3$
$1\frac{4}{10} = 1.4$
$1\frac{5}{10} = 1.5$
$1\frac{6}{10} = 1.6$

2. How is the 2.5 on the ruler read? the 3.5? the 4.5?

3. Read what you see in the box at the right.

4. Write as decimals:

$\frac{2}{10}$ $\quad 1\frac{8}{10}$ $\quad 1\frac{9}{10}$ $\quad 2\frac{1}{10}$ $\quad 2\frac{2}{10}$ $\quad 2\frac{3}{10}$ $\quad 2\frac{4}{10}$

5. Write as common fractions or mixed numbers:

.6 $\quad$ .7 $\quad$ 2.6 $\quad$ 2.7 $\quad$ 2.8 $\quad$ 2.9 $\quad$ 3.0 $\quad$ 3.1

6. Find 5 pairs of matching numbers:

3.2 $\quad$ 2.0 $\quad \frac{2}{10}$ $\quad$ 2.2 $\quad$ 3 $\quad$ .2 $\quad \frac{20}{10}$ $\quad 2\frac{2}{10}$ $\quad \frac{30}{10}$ $\quad 3\frac{2}{10}$

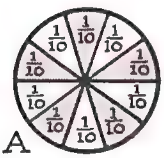
7. Copy and complete this table:

COMMON FRACTIONS	$2\frac{6}{10}$	?	?	$2\frac{9}{10}$	$\frac{30}{10}$	?	?	$99\frac{9}{10}$	$100\frac{1}{10}$	?
DECIMALS	2.6	2.7	2.8	?	?	3.1	9.9	?	?	100.2

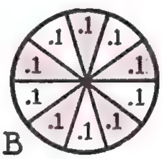
Tenths

Tell the missing decimals in Exs. 1–10. Then copy Exs. 1–5 and write the missing decimals.

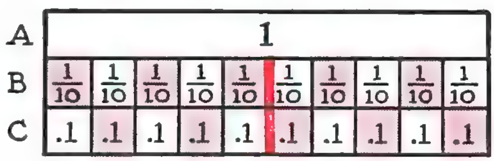
1.	.4	.5	.6	?	?	?	1.0	?	?	1.3
2.	1.4	1.5	1.6	?	?	?	?	?	2.2	2.3
3.	.2	.4	.6	?	?	?	1.4	?	?	2.0
4.	.5	1.0	1.5	?	?	?	3.5	?	?	5.0
5.	2.4	2.6	2.8	?	?	?	3.6	?	?	4.2
6.	9.2	9.6	10.0	?	?	?	11.6	?	?	12.8
7.	1.0	.9	.8	?	?	?	.4	?	?	.1
8.	1.7	1.6	1.5	?	?	?	?	?	?	.8
9.	2.8	2.6	2.4	?	?	?	1.6	?	?	1.0
10.	10.5	9.5	8.5	?	?	?	?	?	?	1.5



A



B



11. Each circle above is divided into ? equal parts.

12. In Circle A show that $\frac{5}{10} = \frac{1}{2}$.

13. In Circle B show that $.5 = \frac{1}{2}$.

14. Does .9 of Circle B equal nearly all of the circle?

15. Is .4 of Circle B more or less than half the circle?

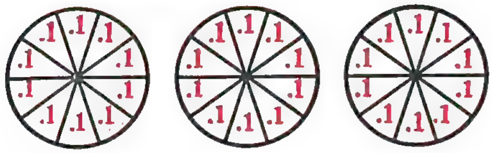
16. If Bar A were divided into 10 equal parts, would it look like Bar B? like Bar C?

17. How is 1 tenth of the bar marked in Bar B? in Bar C?

18. Does $\frac{4}{10}$ of Bar B = .4 of Bar C?

19. Is .6 of Bar C a little more or a little less than half the bar?

Using tenths



Use the circles above to help you answer Exs. 1–4.

1. Which is more, $2\frac{1}{2}$ or 2.6?

2. Are 2.9 circles about 2 circles or about 3 circles?

3. Do 2 whole circles + $\frac{10}{10}$ circle = 3 whole circles?

4. Does 10 tenths = 1 whole? Does 20 tenths = 2 wholes? 30 tenths = _?_ wholes?

5. Write as a common fraction and as a decimal:

10 tenths 20 tenths 30 tenths

Arrange these numbers in order from the smallest to the largest:

6.	$3\frac{1}{2}$	3.4	$\frac{36}{10}$	$3\frac{3}{10}$
7.	2	$1\frac{8}{10}$	$\frac{21}{10}$	1.9

8. Begin with 9.8 and count to 11.2 by tenths. Write the numbers as decimals.

9. You read that 2.9 inches of rain fell. Would you think that about 2 inches, or about $2\frac{1}{2}$ inches, or about 3 inches of rain fell?

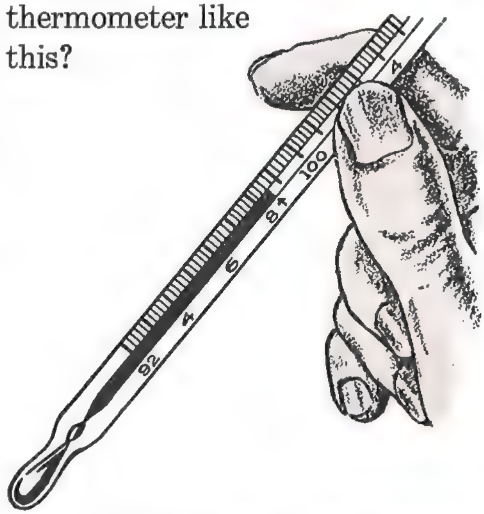
10. If a car travels 19.6 miles, does it travel about 19 miles, or about $19\frac{1}{2}$ miles, or about 20 miles?

11. In 4.4 is the red 4 worth 10 times as much as the black 4?

Is the black 4 worth $\frac{1}{10}$ as much as the red 4? Prove your answer.

12. This is the thermometer George uses to take his temperature. It now reads 98.6°, which is normal body temperature.

Can you explain how to read a thermometer like this?

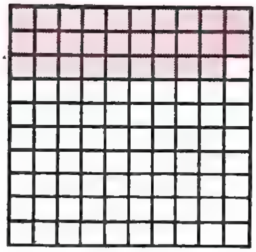


13. If you have a temperature of 99.2°, is your temperature a little above or below normal?

14. One morning George's temperature was 100.2. That afternoon it was 102.

Had his temperature gone up or down? Can you figure out how much?

Hundredths as decimals



1. In the big square, count the number of rows of small squares. Count the squares in a row.

- There are _?_ rows of small squares.
- There are _?_ small squares in each row.
- There are _?_ small squares in all.

2. How many of the small squares are colored?

3. Write a fraction to compare the number of colored squares with the total number of small squares. Are $\frac{29}{100}$ of the small squares colored?

The common fraction $\frac{29}{100}$ and the decimal .29 mean the same. .29 is read *29 hundredths.* When there are *two figures* to the right of a decimal point, they are read as *hundredths.*

4. Write a common fraction that will compare the number of small squares in one row with the total number of squares. Write that fraction as a decimal. Does $\frac{10}{100} = .10$?

5. 2.07 is read "2 *and* 7 hundredths"
2.17 is read "2 *and* 17 hundredths"
How do you read 3.08? 4.16? 5.94?

6. Read what you see in the box at the right.

$\frac{1}{100} =$	.01
$\frac{2}{100} =$	.02
$\frac{3}{100} =$	.03
$\frac{8}{100} =$	.08
$\frac{9}{100} =$	.09
$\frac{10}{100} =$	.10
$\frac{11}{100} =$	.11
$\frac{12}{100} =$	.12
$\frac{98}{100} =$	.98
$1\frac{1}{100} =$	1.01
$1\frac{10}{100} =$	1.10
$1\frac{99}{100} =$	1.99
$2\frac{1}{100} =$	2.01
$9\frac{68}{100} =$	9.68
$12\frac{54}{100} =$	12.54

7. Write as common fractions or mixed numbers:

.17	.05	.13	.75	.07	.90
2.07	3.10	8.45	12.15	20.40	19.76

Write as decimals:

8. $\frac{6}{10}$ $\quad \frac{60}{100}$ $\quad \frac{1}{100}$ $\quad \frac{1}{10}$ $\quad \frac{3}{100}$ $\quad 2\frac{4}{10}$ $\quad 3\frac{4}{100}$

9. $\frac{30}{10}$ $\quad \frac{30}{100}$ $\quad \frac{40}{10}$ $\quad \frac{40}{100}$ $\quad 5\frac{6}{10}$ $\quad 5\frac{65}{100}$ $\quad 7\frac{32}{100}$

10. Write a decimal to compare 1 small square with the total number of small squares in Ex. 1.

Understanding hundredths

Tell the missing numbers:

1. .28	.29	.30	?	?	?	?	.35
2. .60	.58	.56	?	?	?	?	.46
3. 1.00	1.05	1.10	?	?	?	?	1.35
4. 6.25	6.50	?	?	?	?	?	8.00
5. 1.50	2.00	2.50	?	?	?	?	5.00
6. 2.40	2.60	2.80	?	?	?	?	3.80

Copy and complete these tables:

7.

COMMON FRACTION	$\frac{5}{100}$	$\frac{10}{100}$	?	?	$\frac{25}{100}$	?	$\frac{35}{100}$	$\frac{40}{100}$	?	$\frac{50}{100}$
DECIMAL	?	?	.15	.20	?	.30	?	?	.45	?

8.

COMMON FRACTION	?	?	$\frac{6}{100}$	?	$\frac{10}{100}$	$\frac{12}{100}$	$\frac{14}{100}$	?	$\frac{18}{100}$	$\frac{20}{100}$
DECIMAL	.02	.04	?	.08	?	?	?	.16	?	?

9. Begin with 4.96 and count by hundredths to 5.05. Then write the numbers.

10. Begin with 12.03 and count backward by hundredths to 11.94.

11. How many sheets of plastic, each .01 inch thick, would you have to put together to make a piece 1 inch thick?

12. Does .50 = $\frac{50}{100}$ = $\frac{1}{2}$?

13. Is 3.92 feet about 3 feet, about $3\frac{1}{2}$ feet, or about 4 feet?

14. Does $\frac{10}{100} = \frac{1}{10}$? Then does .10 = .1?

15. In 6.66 the red 6 is worth how many times as much as the 6 to the right of it? The red 6 is worth $\frac{1}{10}$ as much as the 6 to the ? of it.

16. Which is more: .1 of a mile or .01 of a mile?

17. Arrange in order of size, beginning with the smallest:

$\frac{1}{2}$ $\quad$ $\frac{3}{10}$ $\quad$ .45 $\quad$ .4 $\quad$ 4.5

Tenths and hundredths

1. Here is a picture of a glass tube. The red marks divide the tube into _?_ equal parts.

2. If the tube is $\frac{1}{10}$ full of liquid, the top of the liquid is at which red mark?

3. Where is the top of the liquid when the tube is $\frac{3}{10}$ full? $\frac{5}{10}$ full? $\frac{9}{10}$ full? $\frac{10}{10}$ full?

4. Where is the top of the liquid when the tube is half full?

5. See if you can figure out into how many equal parts each tenth of the tube is divided. The black marks will help you.

6. Into how many equal parts is .2 of the tube divided? .3 of the tube? .6? .9? the whole tube?

7. The whole tube is divided into 100 equal parts. If the top of the liquid comes up to the first little black line, is the tube .1, or .01 full?

8. Where is the top of the liquid when the tube is .05 full? .09 full? .10 full?

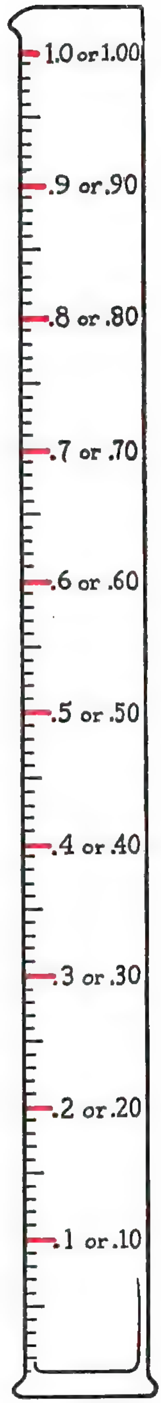
9. Where is the top of the liquid when the tube is .19 full? .20 full? .31 full? .50 full? .75 full? .99 full?

10. When the top of the liquid is at each red mark, how many tenths of the tube is full? how many hundredths of the tube is full? (Begin at the bottom of the tube.)

11. Which is more:

.2 or .19?	.60 or .6?	.9 or .89?	1.0 or .01?
.48 or .5?	.78 or .8?	.4 or .04?	.01 or .10?

12. Where will the top of the liquid be when the tube is .3 full + .03 full? when the tube is .5 full + .07 full?



13. Start at .2 on the tube and count upward to .3 by hundredths.

14. Start at .8 on the tube and count downward to .68 by hundredths.

15. What number is .02 larger than .3?

16. What number is .03 less than .6?

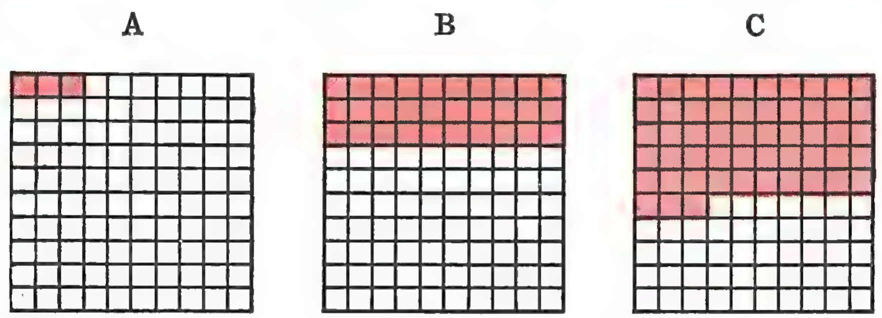
17. If the tube is .1 full of liquid and Ted wants $\frac{1}{2}$ of that liquid, how full will the tube be after Ted pours out what he needs?

18. How much is $\frac{1}{2}$ of .1?

19. Write $2\frac{1}{2}$ tenths as a decimal; write $3\frac{1}{2}$ tenths as a decimal.

20. Does $.3 + .08 = .38$?

21. Count by 5 hundredths to 1.



22. How many rows of small squares are there in Square A? Each row of squares is what part of Square A?

How many small squares are there in each row in Square A? in all of Square A?

23. Each small square is what part of Square A? How many hundredths of Square A are colored?

24. How many rows of squares in Square B are colored? How many tenths of Square B are colored? How many hundredths are colored?

25. Tom says that .53 of Square C is colored. Jerry says that $.5 + .03$ of Square C is colored.

Do you agree with Tom? with Jerry?

26. See if you can tell in two ways what part of Square C is not colored.

27. Write a decimal that means:

- 2 rows of small squares + 5 small squares.
- 2 whole large squares + 3 rows of small squares + 1 small square.

Thousandths

$\frac{1}{1000}$	=	.001
$\frac{2}{1000}$	=	.002
$\frac{3}{1000}$	=	.003
$\frac{5}{1000}$	=	.005
$\frac{6}{1000}$	=	.006
$\frac{9}{1000}$	=	.009
$\frac{10}{1000}$	=	.010
$\frac{12}{1000}$	=	.012
$\frac{100}{1000}$	=	.100
$\frac{999}{1000}$	=	.999
$1\frac{245}{1000}$	=	1.245

1. One thousand sheets of very thin paper make a pack of paper an inch thick. When you compare 1 sheet of the paper with 1000 sheets, would you say that each sheet of paper is $\frac{1}{1000}$ of an inch thick?

The common fraction $\frac{1}{1000}$ and the decimal .001 mean the same thing. .001 is read *one thousandth.* When there are three figures to the right of a decimal point they are read as *thousandths.*

.007 is read "7 thousandths."
.024 is read "24 thousandths."
.156 is read "156 thousandths."
5.284 is read "5 *and* 284 thousandths."

2. Study the fractions and decimals at the right. Then write these fractions as decimals:

$\frac{13}{1000}$ $\frac{25}{1000}$ $\frac{250}{1000}$ $\frac{705}{1000}$ $2\frac{7}{1000}$ $\frac{235}{1000}$

3. The following table will help you to count by thousandths. Read it. Tell the missing numbers.

Row 1	.001	.002	.003	.004	.005	.006	.007	.008	.009	.010
Row 2	.011	.012	.013	.014	.015	.016	.017	.018	.019	.020
Row 3	.021	.022	.023	.024	.025	.026	.027	.028	.029	.030
Row 4	.031	?	?	?	.035	?	?	?	?	.040
Row 5	.041	?	?	.044	.045	.046	?	?	?	.050
Row 6	?	?	.053	?	?	?	.057	?	?	?
Row 7	?	.062	?	?	?	?	?	.068	?	?
Row 8	.071	?	?	?	?	?	?	?	.079	?
Row 9	.081	?	?	?	?	?	?	?	?	.090
Row 10	.091	?	?	?	.095	?	?	?	.099	.100
Row 11	.101	.102	.103	?	?	?	?	?	?	.110

4. What numbers would be in Row 12? Row 13? Row 14?

Further development of tenths, hundredths, thousandths, and their relationships

UNIT 23

Thinking about decimals

1. Write these decimals as common fractions or mixed numbers:

.040 .145 2.005 4.075

2. Bill said that .9 is the largest one-place decimal and that .1 is the smallest one-place decimal.

Do you agree?

What is the largest 2-place decimal? the smallest?

What is the largest 3-place decimal? the smallest?

3. In the number .234 the 2 is in tenths place; the 3 is in ? place; and the 4 is in ? place.

4. Bill said that .234 means $\frac{2}{10} + \frac{3}{100} + \frac{4}{1000}$. Tom said that .234 means $\frac{200}{1000} + \frac{30}{1000} + \frac{4}{1000}$.

How would you show that Bill's $\frac{2}{10}$ equals Tom's $\frac{200}{1000}$? Does Bill's $\frac{3}{100}$ equal Tom's $\frac{30}{1000}$?

5. What does each digit in each of these numbers stand for?

.12 .123 3.01 1.010 2.222

6. Any 3-place decimal is read as thousandths. Any 2-place decimal is read as ?. Any 1-place decimal is read as ?.

7. In .88 the red 8 is worth ? times as much as the black 8.

1 tenth	$\frac{1}{10}$	.1
1 hundredth	$\frac{1}{100}$	.01
1 thousandth	$\frac{1}{1000}$	.001

8. Joan looked at the table above and said, "When I write 1 tenth as a fraction, I have 1 zero in the denominator.

"When I write 1 tenth as a decimal, I have 1 decimal place."

When Joan writes 1 hundredth as a fraction, she writes ? zeros in the denominator; when she writes it as a decimal, she has ? decimal places.

9. When Joan writes 1 thousandth as a fraction she has ? zeros in the denominator; when she writes it as a decimal she has ? decimal places.

10. Mary took .465 apart and put it together this way: →

$$\begin{array}{r} .4 \\ .06 \\ +\ .005 \\ \hline .465 \end{array}$$

George did it this way: →

$$\begin{array}{r} .400 \\ .060 \\ +\ .005 \\ \hline .465 \end{array}$$

Can you show that both were right?

11. In two ways take these decimals apart and put them back together:

.287 .304 .640 .056

Thinking about decimals

1. By what do you divide both numerator and denominator to change $\frac{60}{100}$ to $\frac{6}{10}$?

2. Does Ex. 1 show that .60 equals .6?

3. How can you change $\frac{600}{1000}$ to $\frac{60}{100}$?

4. What does Ex. 3 show about .600 and .60?

5. Does $.6 = .60 = .600$?

6. Does $.4 = .40 = .400$?

7. Write $\frac{9}{10}$ as a decimal. After the .9 write a zero. This is called ***annexing a zero.*** Is .9 changed in value by annexing a zero? Does $.9 = .90$?

8. For each of these decimals write two other decimals that are equal to it:

.3 .50 .800 .20

9. Write .9; then annex 2 zeros. Did you change the value? Does $.9 = .900$?

10. Would .90 be changed in value by dropping or removing the zero? Does $.90 = .9$?

11. Would .900 be changed by removing the two zeros? Does $.900 = .9$?

12. Make up a rule about annexing zeros in a decimal.

13. Make up a rule about dropping zeros in a decimal.

Name the largest and the smallest number in each of Exs. 14–19.

14.	4.008	4.08	4.800
15.	6	5.8	5
16.	3.50	3.49	3.51
17.	60.25	6025	602.5
18.	32.4	3.24	.324
19.	10.1	1.01	.101

20. Which of these numbers are equal to $2\frac{1}{2}$?

2.5 $2\frac{5}{10}$ 2.50 $2\frac{50}{100}$ 2.05 2.500

What whole number is nearest to each of these?

21.	.9	.99	.999	.501
22.	3.8	3.80	3.800	$\frac{19}{5}$
23.	$2\frac{1}{5}$	2.2	2.20	2.05

Which number in each of these pairs is larger?

24. 6.8 in.
.68 in.

25. 75 lb.
7.5 lb.

26. .025 mi.
.25 mi.

27. 10.4 in.
1.048 in.

That important point!

The decimal points in some of these numbers have been omitted *intentionally. Tell where the decimal points should be.*

1. Mr. Lake's car can go 175 mi. on 1 gallon of gasoline.

2. The Wests drive the 1448 mi. to the farm in 4 hours.

3. The thermometer read 56° at 5 A.M. and 828° at 3 P.M.

4. Ted's pedometer showed that he had walked 42 mi. in an hour.

5. Jack's new winter suit cost $2495.

6. A workman repaired the step in 2 hours and was paid $320.

7. Mr. Law worked 485 hr. in the factory last week.

8. The express train traveled 125 mi. a minute.

9. George is in the fifth grade and weighs 6825 lb.

10. Carl ran the 220-yd. dash in 275 seconds.

11. The trailer has 4 bunks, each 25 ft. wide and 6 ft. long.

12. The dwarf was only 32 ft. tall and weighed 46 lb.

The decimal points in some of the numbers in these sentences have been placed incorrectly. *Where do you think the decimal points should be?*

13. The Mercury, a fast express, makes the run at the rate of 7.28 mi. an hour.

14. Three Scouts rode the 36 mi. to camp on bicycles in 42.5 hr.

15. The standing broad jump was won by Jack Shaw, whose jump measured .52 ft.

16. In a fishing contest Tom caught a trout that weighed 4.2 lb. Bob caught one that weighed 40 lb.

17. The paper said that in one hour during a heavy rainstorm 32.0 inches of rain fell.

18. The water at the shallow end of the bathing pool is 25.0 feet deep. The children who cannot swim use this end of the pool.

19. The skirt of Alice's new suit is 1.85 inches long.

20. The average of 4.8 in. and 9.2 in. is .7 in.

Thinking about decimals

1. Copy and complete this table:

Count by 100's	100	200	?	?	500	?	?	?	?	1000
Count by 10's	10	20	?	?	?	?	?	?	?	100
Count by 1's	1	2	3	?	?	?	?	?	?	10
Count by .1's	.1	.2	.3	?	?	?	?	?	?	1
Count by .01's	.01	.02	.03	?	?	?	?	?	?	.10
Count by .001's	.001	.002	.003	?	?	?	?	?	?	.010

2. The counting in Ex. 1 shows that:

$10 \times 100 = \underline{?}$ $\quad 10 \times .1 = \underline{?}$
$10 \times 10 = \underline{?}$ $\quad 10 \times .01 = \underline{?}$
$10 \times 1 = \underline{?}$ $\quad 10 \times .001 = \underline{?}$

3. The counting in Ex. 1 shows that:

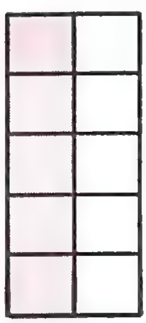
10 tenths = 1 whole
10 hundredths = _?_ tenth
10 thousandths = _?_ hundredth

4. The counting in Ex. 1 shows that:

$\frac{1}{10}$ of $1000 = \underline{?}$ $\quad \frac{1}{10}$ of $1 = \underline{?}$
$\frac{1}{10}$ of $100 = \underline{?}$ $\quad \frac{1}{10}$ of $.1 = \underline{?}$
$\frac{1}{10}$ of $10 = \underline{?}$ $\quad \frac{1}{10}$ of $.01 = \underline{?}$

5. This rectangle is divided into _?_ equal parts.

Write 2 common fractions and one decimal, each of which shows what part of the rectangle is colored.



6. Which of the following does .49 mean?

about $\frac{1}{2}$ $\quad .40 + .09 \quad \frac{40}{100} + \frac{9}{100}$
$\frac{49}{100} \quad .4 + .09 \quad .9 + .04$

7. Which of the following does .512 mean?

about $\frac{1}{2}$ $\quad .51 + .002$
$.500 + .010 + .2 \quad \frac{512}{1000}$
$.5 + .01 + .002 \quad \frac{500}{1000} + \frac{1}{100} + \frac{2}{10}$

8. In the number 777.777, each 7 is worth 10 times as much as the 7 to the _?_ of it.

Each 7 in the number is worth $\frac{1}{10}$ as much as the 7 to the _?_ of it.

9. What is the smallest number you know how to write using the figures 1, 2, and 3?

What is the largest number you can write with these figures?

10. If you have a 100-bead frame, show that $\frac{1}{10}$ of the beads is 10 times as many as $\frac{1}{100}$ of them.

Oral practice with decimals

1. Is four *and* five hundredths written 4.50, 4.5, or 4.05?
2. Is eight *and* forty-five hundredths written 8.45, 8.045, or 84.5?
3. Is one hundred *and* twelve hundredths written 100.012, 100.12, or .112?
4. Is $8\frac{55}{100}$ written 8.55, 8.055, or 85.5?
5. Is $\frac{54}{100}$ written 54, 5.4, or .54?
6. Is $6\frac{5}{10}$ written 65, 6.5, or 6.05?
7. Is $\frac{1}{100}$ written .100, 1.00, or .01?
8. Is $\frac{2}{100}$ written .20, .02, or .200?
9. Is .003 read 3 tenths, 3 hundredths, or 3 thousandths?
10. Is 6.600 equal to $6\frac{6}{100}$, $6\frac{6}{10}$, or $6\frac{6}{1000}$?
11. Is 20.05 equal to $20\frac{5}{10}$, $20\frac{5}{1000}$, or $20\frac{5}{100}$?
12. Is 4.036 equal to $4\frac{36}{100}$, $4\frac{36}{1000}$, or $40\frac{36}{100}$?

Written practice with decimals

Write each of the following numbers in decimal form:

	a	*b*	*c*	*d*	*e*	*f*
1.	$8\frac{5}{10}$	$14\frac{2}{10}$	$80\frac{8}{10}$	$\frac{1}{100}$	$10\frac{19}{100}$	$60\frac{6}{100}$
2.	$\frac{76}{100}$	$25\frac{5}{100}$	$\frac{27}{1000}$	$70\frac{7}{10}$	$8\frac{5}{100}$	$21\frac{4}{10}$
3.	$3\frac{26}{100}$	$\frac{3}{1000}$	$90\frac{8}{100}$	$\frac{5}{1000}$	$2\frac{24}{1000}$	$9\frac{9}{100}$

4. Nineteen hundredths
5. Twenty-nine thousandths
6. Thirty-seven hundredths
7. One thousand two hundred and twelve hundredths
8. One thousand and thirty-six hundredths

Arithmetic roundup

▶ Oral review

1. What part of a pound is each of these?

3 oz. 4 oz. 8 oz. 10 oz. 12 oz.

2. What years were these?

MDCLXVI MDLV MCMXI

3. Change these to improper fractions:

$1\frac{2}{3}$ $3\frac{1}{2}$ $2\frac{3}{4}$ $4\frac{2}{3}$ $5\frac{1}{6}$

4. Reduce to lowest terms:

$\frac{8}{12}$ $\frac{12}{16}$ $\frac{20}{100}$ $\frac{40}{1000}$ $\frac{50}{100}$

5. What is an easy way to tell which is larger, $\frac{3}{4}$ or $\frac{11}{16}$?

6. Alice made 3 quarts of marmalade. How many half-pint jars will she need to hold it all?

7. Read this number: 7,046,354

8. Round off these numbers to hundreds and read them:

629 897 230 341 758

9. At 48¢ a dozen, how much will 10 apples cost?

10. At 4 for 15¢, how much will you pay for 2 dozen pencils?

11. Give the sum of each:

$\frac{1}{8}+\frac{5}{8}$ $\frac{2}{5}+\frac{3}{5}$ $\frac{3}{10}+\frac{9}{10}$

12. $\frac{1}{2}$ is how much more than $\frac{3}{8}$? than $\frac{3}{10}$? than $\frac{3}{16}$?

13. What is $\frac{1}{2}$ of $\frac{1}{2}$? $\frac{1}{2}$ of $\frac{1}{4}$?

14. How many $\frac{1}{2}$ inches are there in 8 inches?

▶ Written review

1.
$$\begin{array}{r} \$46.83 \\ 12.00 \\ 98.76 \\ 26.84 \\ 35.79 \\ \underline{8.68} \end{array}$$

2. Take \$475.58 from \$500.

3. Multiply 4,069 by 560.

4. 57,324 ÷ 68

5. $23\overline{)\$10.58}$

6. $75\overline{)60037}$

7. $55\overline{)6703}$

8. $89\overline{)5389}$

9. $95\overline{)38754}$

10.
$$\begin{array}{r} 16\frac{3}{4} \\ \underline{+\,8\frac{1}{3}} \end{array}$$

11.
$$\begin{array}{r} 6\frac{1}{10} \\ \underline{-\,1\frac{4}{5}} \end{array}$$

12.
$$\begin{array}{r} 24 \\ \underline{\times\,1\frac{2}{3}} \end{array}$$

13.
$$\begin{array}{r} \$1.89 \\ \underline{\times\,2\frac{1}{4}} \end{array}$$

14. Divide 4.80 by $2\frac{2}{5}$; $\frac{3}{4}$ by $1\frac{1}{2}$; $1\frac{7}{8}$ by 4; $6\frac{2}{5}$ by $1\frac{2}{3}$.

Review of common fractions

Watch the signs!

	a	b	c	d
1.	$6 \div \frac{1}{3}$	$\frac{5}{6} \div 2\frac{1}{2}$	$\frac{8}{9} \times \frac{3}{4}$	$8 \div 1\frac{1}{3}$
2.	$3\frac{3}{4} \times \frac{2}{3}$	$8 \times \frac{3}{16}$	$8 \div \frac{4}{5}$	$6\frac{2}{3} \times 3$
3.	$\frac{7}{8} \div 3\frac{1}{2}$	$1\frac{2}{3} \div 5$	$\frac{2}{3} \times \frac{2}{5}$	$\frac{3}{4} \div 9$
4.	$10 \times 3\frac{1}{5}$	$1\frac{2}{3} \div \frac{1}{5}$	$3\frac{1}{5} \div 1\frac{3}{5}$	$\frac{3}{5} \times 15$
5.	$2\frac{1}{4} \times 1\frac{1}{2}$	$\frac{3}{5} \times 1\frac{1}{4}$	$\frac{3}{5} \div \frac{2}{3}$	$3\frac{1}{2} \div 1\frac{2}{3}$
6.	$1\frac{5}{6} + \frac{1}{4} + 1\frac{11}{12}$	$2\frac{1}{6} + 10\frac{1}{2}$	$6\frac{5}{8} - 2$	$8\frac{1}{2} - \frac{9}{10}$
7.	$\frac{5}{6} + \frac{1}{2} + \frac{1}{12}$	$4\frac{1}{4} + 1\frac{2}{5}$	$3\frac{7}{12} - 2\frac{1}{6}$	$9 - 1\frac{4}{5}$
8.	$\frac{5}{9} + \frac{5}{9} + \frac{8}{9}$	$6\frac{1}{6} + 1\frac{3}{4}$	$5\frac{4}{5} - 1\frac{1}{2}$	$7\frac{2}{3} - \frac{5}{6}$
9.	$\frac{2}{5} + \frac{1}{2} + 1\frac{9}{10}$	$8\frac{5}{16} + 2\frac{5}{8}$	$4\frac{1}{8} - \frac{3}{4}$	$10 - 3\frac{5}{8}$
10.	$8 \times \$.62\frac{1}{2}$	$18 \times \$.31\frac{3}{4}$	$8\frac{1}{4} \times \$2.80$	$3\frac{1}{4} \times \$3.00$

11. A recipe for soap calls for $2\frac{1}{2}$ lb. of fat, $\frac{3}{4}$ tablespoon of borax, $\frac{1}{4}$ cup of ammonia, $\frac{1}{2}$ lb. of lye, and $1\frac{1}{2}$ pt. of water.

If a science club wishes to make 3 times the recipe, how much fat will they need? lye? ammonia? borax? water?

12. In making punch, Lois used 2 cups of orange juice, $\frac{3}{4}$ cups of lemon juice, and $1\frac{1}{2}$ cups of cherry juice.

How much ice water did she need to add to make 5 cups of punch?

13. Arthur needs 6 lb. of cement for the concrete he is mixing. He has $2\frac{1}{4}$ lb.

His father says he can take as much more as he needs from an unopened 10-pound sack. How much cement should he take?

14. How many rows of flower seeds can Judy plant in a seedbed 15″ wide if she allows $2\frac{1}{2}$″ between rows? This is tricky. A drawing will help you.

15. If $15 \div 1\frac{1}{4} = 12$, then you know that $30 \div 1\frac{1}{4} =$?.

Be your own teacher

You have never been taught how to read a pedometer, but you can teach yourself. Try to answer the questions below.

Look at the picture of the pedometer above. By ticking off each step a pedometer measures the number of miles a person walks.

The large hand moves in the same direction as the hands of a clock. The small hand moves at the same time the large hand moves, but it moves much more slowly. It moves in the opposite direction from the hands of a clock.

1. How does the large hand show that a person has walked 1 mi.? 3 mi.? 5 mi.? 10 mi.? $\frac{1}{2}$ mi.? $\frac{1}{4}$ mi.? $2\frac{1}{2}$ mi.? $7\frac{1}{4}$ mi.?

2. How does the small hand on the pedometer show that a person has walked 10 mi.? 20 mi.? 30 mi.? 40 mi.? 80 mi.? 100 mi.?

3. The pedometer at the top of this column registers in all 30 mi. + $1\frac{1}{4}$ mi., or _?_ mi.

4. How many miles does this pedometer register?

5. How far did Roger hike if his pedometer looked like this before and after the hike?

Before

After

To the Teacher: See Note 7 on page 310.

Adding decimals

1. How long is the road from Jonesboro to Ferndale? Tell if each of these solutions is correct:

- 4 tenths + 3 tenths = 7 tenths
- $\frac{4}{10} + \frac{3}{10} = \frac{7}{10}$
- $.4 + .3 = .7$

2. Do the additions in this box say the same thing?

$$\begin{array}{r} \frac{1}{10} \\ +\ \frac{6}{10} \\ \hline \frac{7}{10} \end{array} \qquad \begin{array}{r} .1 \\ +\ .6 \\ \hline .7 \end{array}$$

Find an addition in Ex. 4 to match each addition in Ex. 3.

3. $\begin{array}{r} \frac{2}{10} \\ +\ \frac{5}{10} \\ \hline \frac{7}{10} \end{array} \qquad \begin{array}{r} \frac{8}{10} \\ +\ \frac{5}{10} \\ \hline \frac{13}{10} = 1\frac{3}{10} \end{array} \qquad \begin{array}{r} \frac{9}{10} \\ +\ \frac{8}{10} \\ \hline \frac{17}{10} = 1\frac{7}{10} \end{array}$

4. $\begin{array}{r} .9 \\ +\ .8 \\ \hline 1.7 \end{array} \qquad \begin{array}{r} .2 \\ +\ .5 \\ \hline .7 \end{array} \qquad \begin{array}{r} .8 \\ +\ .5 \\ \hline 1.3 \end{array}$

Find an addition in Ex. 6 to match each addition in Ex. 5.

5. $\begin{array}{r} 2\frac{7}{10} \\ +4\frac{6}{10} \\ \hline 6\frac{13}{10} = 7\frac{3}{10} \end{array} \qquad \begin{array}{r} 5\frac{1}{10} \\ +8\frac{8}{10} \\ \hline 13\frac{9}{10} \end{array} \qquad \begin{array}{r} 2\frac{9}{10} \\ +\frac{8}{10} \\ \hline 2\frac{17}{10} = 3\frac{7}{10} \end{array}$

6. $\begin{array}{r} 2.9 \\ +\ .8 \\ \hline 3.7 \end{array} \qquad \begin{array}{r} 5.1 \\ +\ 8.8 \\ \hline 13.9 \end{array} \qquad \begin{array}{r} 2.7 \\ +\ 4.6 \\ \hline 7.3 \end{array}$

7. Do these two additions say the same thing?

$$\begin{array}{r} 2\frac{37}{100} \\ +\ 5\frac{12}{100} \\ \hline 7\frac{49}{100} \end{array} \qquad \begin{array}{r} 2.37 \\ +\ 5.12 \\ \hline 7.49 \end{array}$$

How is the addition in Column A like the addition in Column B? How is it different?

	A	B
8.	$\begin{array}{r} \$\ 5.72 \\ 4.83 \\ \hline \$10.55 \end{array}$	$\begin{array}{r} 5.72 \\ 4.83 \\ \hline 10.55 \end{array}$
9.	$\begin{array}{r} \$\ 5.624 \\ 8.974 \\ 9.763 \\ \hline \$24.361 \end{array}$	$\begin{array}{r} 5.624 \\ 8.974 \\ 9.763 \\ \hline 24.361 \end{array}$

10. When you add two or more three-place decimals, you add thousandths to thousandths, hundredths to hundredths, and tenths to _?_. Use Ex. 9 to illustrate this fact.

11. When you add decimals, do the decimal points in the addends and in the sum come one under the other? Why?

Copy in columns, add, and check:

12. $.4 + .9 + .7 + .6 + .3$

13. $2.5 + 3.4 + .8 + .7 + 1.6$

14. $3.76 + 4.28 + 5.00 + .35$

Subtracting decimals

A

$$\begin{array}{r} 8\frac{7}{10} \\ -\ 2\frac{3}{10} \\ \hline 6\frac{4}{10} \end{array} \qquad \begin{array}{r} 8.7 \\ -\ 2.3 \\ \hline 6.4 \end{array}$$

B

$$\begin{array}{rcl} 9\frac{3}{10} & = & 8\frac{13}{10} \\ -\ 4\frac{7}{10} & = & 4\frac{7}{10} \\ \hline & & 4\frac{6}{10} \end{array} \qquad \begin{array}{r} 9.3 \\ -\ 4.7 \\ \hline 4.6 \end{array}$$

C

$$\begin{array}{r} {\scriptstyle 7\ 9\ 10} \\ \$\cancel{8}.\cancel{0}\,\cancel{0} \\ -\ 3.4\,5 \\ \hline \$4.5\,5 \end{array} \qquad \begin{array}{r} {\scriptstyle 7\ 9\ 10} \\ \cancel{8}.\cancel{0}\,\cancel{0} \\ -\ 3.4\,5 \\ \hline 4.5\,5 \end{array}$$

1. Study the three pairs of subtractions in the boxes above.

Does the first example in each pair teach you how to do the second example in the pair?

> When you subtract decimals, be sure that the decimal points are written one under the other.
>
> Where do you write the decimal point in the answer?

Do these subtractions. Check each one.

	a	*b*	*c*	*d*	*e*	*f*
2.	7.65 2.08	4.54 1.37	5.89 1.80	6.275 2.540	19.15 6.50	8.075 2.240
3.	5.8 2.5	8.25 4.38	7.98 2.50	4.506 .490	24.06 7.60	86.12 8.80
4.	9.67 4.75	6.89 5.65	8.92 .70	17.08 6.60	8.006 .240	.975 .460

5. Subtract two dollars and forty-five cents from five dollars. How do you write the five dollars?

6. When you subtract 2.45 from 5, how should you write the example?

7. In which of the two ways shown at the right would you write the example in order to subtract 3.76 from 5.2? Why?

$$\begin{array}{r} 5.2 \\ 3.76 \\ \hline \end{array} \qquad \begin{array}{r} 5.20 \\ 3.76 \\ \hline \end{array}$$

Subtract and check:

	a	*b*	*c*	*d*
8.	\$5 – \$4.26	\$8 – \$3.27	6 – 2.8	6.5 – 4.26
9.	\$10 – \$4.50	\$26 – \$4.23	7 – 3.5	10.3 – 5.38

Practice with decimals

1. Phil has a gadget on his bicycle that measures how far he rides. Monday he rode 7.5 miles, Tuesday 6.8 miles, and Wednesday 8.2 miles.

How far did Phil ride in the three days?

2. How much farther did Phil ride on Monday than on Tuesday?

3. How much farther did he ride on Wednesday than on Monday?

4. How much change should Gordon receive from three 10-dollar bills if he spends \$18.75 for a radio and \$8.58 for bicycle repairs?

5. At the school track meet Dan ran the 220-yd. dash in 29.2 sec. Ted Martin ran it in 28.0 sec.

Dan came in _?_ sec. after Ted.

6. How many sheets of metal each .1 in. thick are needed to make a thickness of 1 in.?

Subtract and check:

	a	b	c	d
7.	8.76 − 5.58	6.48 − 2.97	10.1 − 10.01	5 − 2.52
8.	3.82 − 2.98	5.65 − 3.254	20.7 − 2.07	7 − 6.48
9.	.754 − .25	2.75 − 1.39	63.0 − 50.0	4 − 2.5
10.	.806 − .705	.824 − .17	4.75 − 2.635	9 − .25
11.	12.43 − 3.25	9.56 − 3.84	7.54 − 5.27	8 − .64

12. $2.3 + 2.3 + 2.3 + 2.3 + 2.3 + 2.3 =$ _?_

13. Ex. 12 shows that $13.8 \div 2.3 =$ _?_ .

14. $1.5 + 1.5 + 1.5 + 1.5 + 1.5 + 1.5 + 1.5 =$ _?_

15. Ex. 14 shows that $7 \times 1.5 =$ _?_ .

16. $1 + .1 + 1.1 + .11 + .01 + 1.11 =$ _?_

17. $2.5 + 4 + 3.4 + 5.2 + 3.25 + 43 =$ _?_

18. Copy and complete: .96, .97, _?_, _?_, _?_, _?_, 1.02.

Changing decimals to fractions

Tell the missing numbers:

	a	b	c
1.	$.1 = \frac{?}{10}$	$.05 = \frac{?}{100} = \frac{?}{20}$	$4.5 = 4\frac{5}{10} = 4\frac{1}{?}$
2.	$.2 = \frac{?}{10} = \frac{?}{5}$	$.25 = \frac{?}{100} = \frac{?}{4}$	$6.8 = 6\frac{8}{10} = 6\frac{?}{?}$
3.	$.3 = \frac{?}{10}$	$.75 = \frac{?}{100} = \frac{?}{?}$	$7.2 = 7\frac{?}{10} = 7\frac{?}{?}$
4.	$.4 = \frac{?}{10} = \frac{?}{5}$	$.50 = \frac{?}{100} = \frac{?}{?}$	$9.4 = 9\frac{?}{?} = 9\frac{?}{?}$
5.	$.5 = \frac{?}{10} = \frac{?}{2}$	$.60 = \frac{?}{100} = \frac{?}{?}$	$3.5 = 3\frac{?}{?} = 3\frac{?}{?}$

Change to common fractions or mixed numbers:

	a	b	c	d	e	f	g	h
6.	.6	.8	8.6	6.7	.08	.35	2.9	9.05
7.	.7	.9	7.8	9.9	.15	.40	3.3	8.55

8. Write as decimals:

$8\frac{8}{10}$ $\quad 8\frac{8}{100}$ $\quad 8\frac{8}{1000}$

9. Write a common fraction to compare 35 years with a century.

Now write a decimal which tells what part of a century is 35 years.

10. Nan says she lives $8\frac{1}{2}$ mi. from Leeds. A timetable gives the distance decimally as _?_ mi.

11. Tom says his house lot is $152\frac{1}{4}$ ft. wide along the road. Write this distance using a decimal.

A matching contest

Find the fractions in the B columns that match the decimals in the A columns.

	A	B		A	B		A	B
1.	.8	$\frac{4}{5}$	5.	.30	$\frac{2}{5}$	9.	4.25	$4\frac{3}{4}$
2.	.5	$\frac{3}{4}$	6.	.40	$\frac{3}{10}$	10.	4.75	$4\frac{2}{5}$
3.	.25	$\frac{1}{2}$	7.	4.5	$4\frac{4}{5}$	11.	4.4	$4\frac{1}{4}$
4.	.75	$\frac{1}{4}$	8.	4.80	$4\frac{1}{2}$	12.	4.35	$4\frac{7}{20}$

A page of problems

1. Tony bought 4 pkg. of screws for $1.36. How much should he charge Sam for two of the packages? He does not wish to gain or lose on the sale.

2. The sign below is at the crossroads in Chester:

LIBERTY: 78.6 mi. ⟶
⟵ MILTON: 65.8 mi.

How far is it from Liberty to Milton?

3. A lot is 108.8 ft. long and 58.9 ft. wide. What is its perimeter in feet?

4. Ted says his step is $2\frac{1}{2}'$ long and that he took 86 steps going from his home to Broad Street.

How many feet is it from Ted's home to Broad Street?

Use Ted's method to "step off" some distances.

5. A nautical or sea mile is 6080.20 ft. long. How many feet longer is it than a land mile?

6. Between Dec. 1 and Feb. 1 last year the snowfall in Essex was 18.2 in. During the same period this year 14.3 in. of snow fell.

How much greater was the snowfall last year than this year?

7. On a railroad that charges $3\frac{6}{10}$¢ a mile, what will be the fare for a trip of 350 miles?

8. At $18\frac{1}{2}$¢ a foot, how much will Ray pay for a piece of chain 4′ 8″ long?

9. Donna bought 12 cans of peas on sale at 2 cans for 35¢. The regular price is 20¢ a can. How much did she save on the 12 cans?

10. At $6 a dozen, how much will Jean pay for 15 photographs?

11. John can buy 3 T-shirts for one dollar. How many can he buy for four dollars?

12. Pete can buy 6 cans of dog food for 89¢. How much will 30 cans cost?

13. A road-building report says the distance between two cities is 78.78 miles.

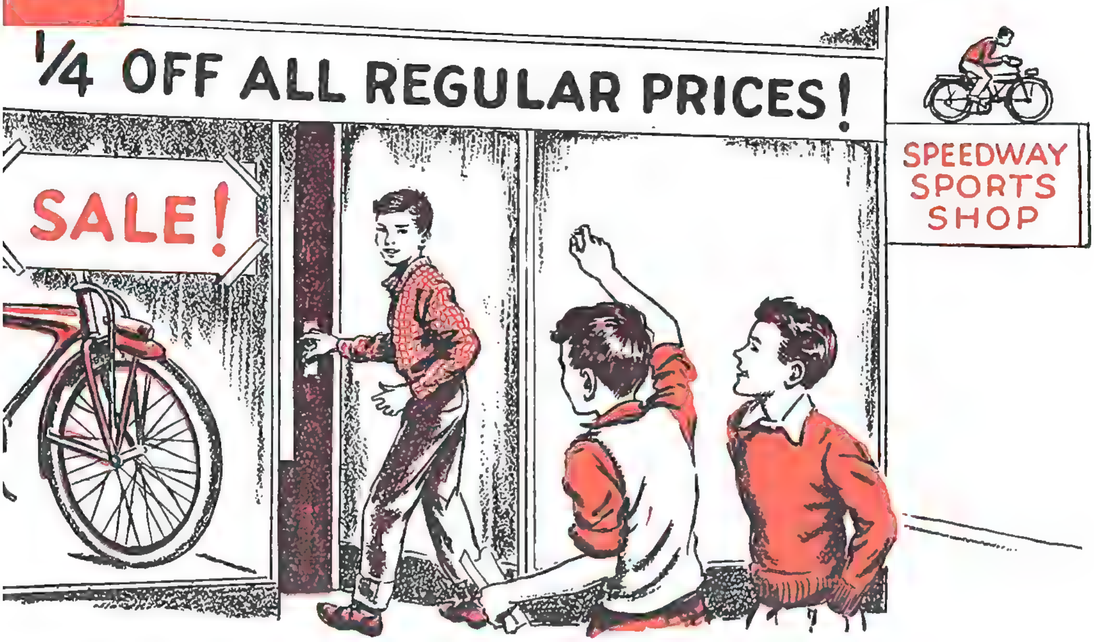
Is the distance between the cities about 78 mi., $78\frac{1}{2}$ mi., $78\frac{3}{4}$ mi., or 79 mi.?

14. Bill and his father drove 147 miles in $3\frac{1}{2}$ hours. They averaged __?__ miles an hour on the trip.

15. At 60¢ an hour, how much can you earn in 3 hr., 45 min.?

UNIT 25

Finding sale prices
Reading tables
Maintenance



Finding sale prices

1. The regular selling price is given for each item below. Find the sale price at the "$\frac{1}{4}$ off" sale.

If the amount to be taken off ends in a fraction of a cent, drop the fraction. Do you know why?

Handle bars	$1.00
Handle-bar grips (pr.)	$ .48
Pedals (pr.)	$1.10
Wire basket	$ .95
Seat	$1.89
Chain	$1.39
Tire	$2.29
Coaster brake	$4.79

2. Find the sale price of the following at a "$\frac{1}{3}$ off" sale:

Punching bag	$4.85
First-baseman's mitt	$8.45

3. Jack bought a dry-cell battery regularly priced at $.50, a drawing board marked 79¢, and a set of paints marked 45¢.

How much did Jack pay for all these at $\frac{1}{4}$ off the regular price?

4. Tom bought a microscope regularly priced at $2.98 and a collection of minerals marked $2.29.

How much did Tom pay for both at $\frac{1}{4}$ off the regular price?

5. Polly bought a box camera marked $3.95, 3 rolls of film at 29¢ a roll, and a plastic carrying case for the camera at $.89.

How much did Polly spend if she was given $\frac{1}{10}$ off the total bill?

Tables of information

THE GREAT LAKES					
	SUPERIOR	MICHIGAN	HURON	ERIE	ONTARIO
Length in miles	350	307	206	241	193
Width in miles	160	118	102	57	53
Deepest sounding in feet	1,290	923	750	210	778
Area in square miles in United States	20,710	22,400	9,110	4,990	3,560
in Canada	11,110	. . .	13,900	4,950	3,980
No. of feet above sea level	602.13	579.74	579.74	571.82	245.62

Above are some facts about the Great Lakes. The facts are arranged in a table.

Do you see how easily the lakes can be compared when the facts are arranged in this way?

1. Which lake has the greatest length? the greatest width?

2. What is the deepest sounding in Lake Superior? in Lake Erie? in Lake Ontario?

3. Give the area of the water surface in the United States and Canada together for each lake.

4. Which lake is wholly in the United States?

5. Which lake is farthest above sea level? Which one is nearest to sea level?

Study this table of distances from Fort Wayne to Chicago.

The first number tells that it is 18.9 miles from Fort Wayne to Columbia City.

MILES FROM FORT WAYNE	FORT WAYNE, IND. TO CHICAGO, ILL.
18.9	Columbia City
39.3	Warsaw
64.2	Plymouth
104.8	Valparaiso
123.4	Gary
148.0	Chicago

How far is it from:

6. Fort Wayne to Valparaiso? Fort Wayne to Gary?

7. Columbia City to Plymouth?

8. Warsaw to Gary?

9. Gary to Columbia City?

Problem study helps

If you have trouble with Problem 1 in Column A, do Problem 1 in Column B. Then go back and try Problem 1 in Column A again, and so on.

A

1. Ann timed herself and found she can print 4 tickets in 10 min. How many tickets can she print in $\frac{1}{2}$ hr.; in 1 hr.?

2. Where should the decimal point be placed in this statement? Fred sleeps 105 hr. every night.

3. How many square feet are there in a canvas boat cover 12 ft. long and 10 ft. wide?

4. How many feet of weather stripping will Henry need to tack around all four edges of a cabin door that is 6′ high and $2\frac{1}{2}'$ wide?

5. If oranges are selling at 5 for 19¢, find the cost of a dozen oranges.

6. What is the average of $2\frac{4}{5}$, $3\frac{1}{5}$, and 5?

7. Bill bought 4 plastic bars, each weighing $2\frac{1}{2}$ oz. How many ounces of plastic did he buy?

   What part of a pound is 10 oz.?

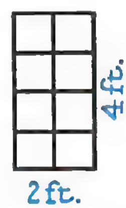
8. When a plane travels 350 miles in $3\frac{1}{2}$ hr., at what rate is it going?

B

1. Jane can peel 3 large potatoes in 5 minutes. Draw a picture to show how many she can peel in 10 min.; in 15 min.

2. Would a boy usually sleep about 1 hr., about 10 hr., or about 105 hr. in a night?

3. In this rectangle there are ? square feet in each row; ? rows; ? square feet all together.



4. What is the distance around the rectangle shown in Ex. 3?

5. Make up a rule to show how to find the cost of 6 apples at 2 for 5¢.

6. Find the average of 4, 5, 6. ($4 + 5 + 6 =$?. $15 \div 3 =$?.)

7. Two pears each weighing $1\frac{1}{2}$ oz. will together weigh ? oz.

   Write a fraction to compare 1 oz. with 1 lb.; 3 oz. with 1 lb.

8. If John walks 8 miles in 2 hr., he walks at the rate of ? mi. an hour. Draw a picture.

Arithmetic roundup

Oral review

1. Is the answer to $2\frac{1}{4} \times 3\frac{7}{8}$ nearer to 6 or to 9? Why?

2. Does $8\frac{1}{8} \div 1\frac{15}{16}$ equal about 8 or about 4? Why?

3. Tell which is greater: 1.08 in. or 1.2 in.; 2.2 mi. or 1.95 mi.

4. Which is larger, $\frac{3}{4}$ or $\frac{5}{6}$?

5. Add 26 to 37; to 49; to 68.

6. Take 38 from 45; from 57.

7. Multiply 86 by 8; by 9.

8. Divide 53 by 7; by 8; by 9.

9. A 3-inch line drawn to a scale of $\frac{1}{4}'' = 1$ ft. represents a distance of _?_ ft.

10. Add: $.8 + .5 + .3 + .7 + .6$

11. Find an error in this counting: 4.64 4.94 5.24 5.64

12. Read: 19.15 3.082

Written review

1. Divide $4\frac{3}{4}$ by $2\frac{1}{2}$.

2. Multiply $9\frac{1}{3}$ by $3\frac{1}{4}$.

3. Find the sum of $1\frac{3}{4}$, $2\frac{7}{8}$, $5\frac{1}{2}$.

4. Subtract $8\frac{5}{6}$ from $12\frac{1}{4}$.

5. What is the difference between 8.55 and 8.5?

6. Add $.82 + .28 + .65 + .44$

7. Add $5.6 + 80.3 + 18.3$

8. Add $6.08 + 7.6 + 13.75$

9. Add $10 + 16.46 + 1.8$

10. 805.2 is _?_ more than 275?

11. 27.86 and _?_ makes 86.4.

12. Multiply 675 by 805.

13. Multiply $26.38 by 70.

14. Divide 5,568 by 87.

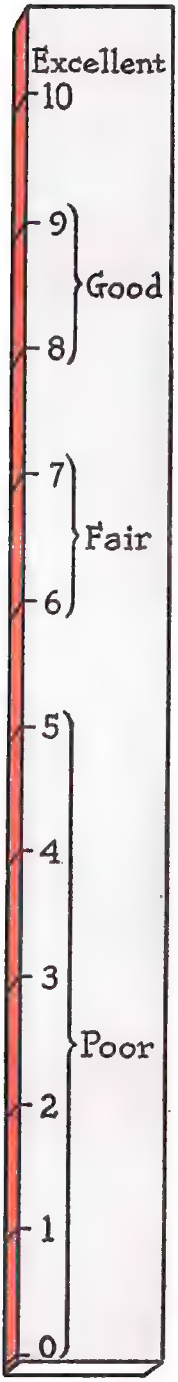
15. Divide $2,041.02 by 34.

16. How many $5\frac{1}{2}$-foot lengths are there in 528 ft.?

17. How much less than 10 yd. is $7\frac{5}{8}$ yd.?

18. Sam weighed $81\frac{3}{4}$ lb. on his birthday last year and $89\frac{1}{4}$ lb. this year. He gained _?_ lb. in a year.

Problem Test 4



Measure your growth in problem solving.

1. Find the cost of $2\frac{3}{4}$ lb. of hot dogs at 48¢ a pound, and 2 dozen hot dog rolls at 24¢ a dozen.

2. Bob weighed himself and his dog Rex together. They weighed $96\frac{1}{4}$ lb. Then Bob weighed himself and found he weighed $88\frac{3}{4}$ lb. How much did Rex weigh?

3. Allan's tent floor is 10 feet square. What is the area of his tent floor? the perimeter?

4. Each week Arnold mixes 16 lb. of corn and 8 lb. of wheat for his chickens. How much grain does he feed his chickens each week? What part of the mixture is corn?

5. How much change should you receive from a 10-dollar bill after buying two full-fare tickets and one half-fare ticket, when a full-fare ticket costs $1.56?

6. Martha wants a nylon-bristle hairbrush which sells for $2.50. She can get it at a sale at $\frac{1}{4}$ off the regular price. What is the sale price of the hairbrush?

7. Sam needs a strip of sailcloth to repair the sail on his iceboat. How much will $\frac{3}{8}$ yd. cost at $2.49 a yard?

8. How much will Vernon save by buying a gallon can of turpentine for $2.79 instead of buying a gallon in four quart cans at 79¢ each?

9. Rose buys a magazine every week for 10¢. How much would she save in a year if she bought a year's subscription for $3.50?

10. The thermometer shows that Barbara's temperature was 100° this morning. The normal body temperature is 98.6°. How far above normal was Barbara's temperature?

Record your score on your Problem Test Record.

Self-Help Test 5

1. Express as common fractions (or mixed numbers) reduced to lowest terms:

.40 .6 1.4 5.5 20.75 **(157, 161)**

2. $6.50 + .82 + 65.07$ **(173)**

3. What must be added to 2.56 to make 5.43? **(174)**

4. $\frac{3}{4} \div \frac{2}{3}$ **(136)**

5. $\frac{1}{4} \div 5$ **(137)**

6. $12 \div \frac{3}{4}$ **(130–131)**

7. $4\frac{3}{4} \div 5$ **(141)**

8. $\frac{5}{6} \div 3\frac{1}{3}$ **(142)**

9. $\$3.60 \div 1\frac{1}{3}$ **(135)**

10. What is the average of these numbers?

22, 19, 25, 16, and 28 **(54)**

11. Mr. Ball has driven 450 mi. of a 625-mi. trip. How long will it take him to complete the trip at an average speed of 35 mi. an hour? **(99)**

12. How many strips, each $2\frac{1}{2}$ ft. long, can be cut from a piece of felt window stripping that is $17\frac{1}{2}$ ft. long? **(143)**

Self-Help Test 6

1. Write this amount in figures: 18 billion, 505 million. **(8–9)**

2. Round off to the nearest thousand: 3,409 9,864 **(10)**

3. Write as decimal fractions: $\frac{7}{100}$ $1\frac{3}{10}$ $4\frac{18}{100}$ $\frac{75}{1000}$ **(157, 169)**

4. What part of a 60-cent pound of candy can Ellen buy with 3 nickels? **(161)**

5. At \$1.75 a yard, $5\frac{3}{8}$ yd. of cloth will cost _?_. **(96)**

6. $\frac{3}{4}$ of 15 **(91)**

7. $6 \times \frac{3}{5}$ **(86)**

8. $15\frac{7}{8} + \frac{7}{16}$ **(68)**

9. $\frac{5}{6} \times 1\frac{1}{8}$ **(110)**

10. $\frac{7}{8} \times \frac{4}{5}$ **(90)**

11. $8\frac{1}{4} - 1\frac{7}{12}$ **(72)**

12. $1\frac{3}{4} \times 24$ **(95)**

13. $5\frac{1}{3} \times 3\frac{3}{4}$ **(111)**

14. $14\frac{4}{5} - 4\frac{1}{2}$ **(72)**

Measuring your growth in arithmetic

Copy the examples correctly. Work carefully. Check your answers. Be sure your answers are sensible.

1. Write in figures: three hundred eighteen and sixty-nine hundredths.

2. Copy and complete:

$.4 = \frac{?}{10} = \frac{?}{5}$ $.25 = \frac{25}{?} = \frac{1}{?}$ $.45 = \frac{45}{?} = \frac{9}{?}$

3. Write as decimals:

$\frac{8}{10}$ $2\frac{28}{100}$ $18\frac{4}{100}$ $\frac{5}{1000}$

4. Arrange these numbers in order of size, beginning with the largest:

5.5 .005 5.55 .05 5 $\frac{1}{2}$

5. 6.3 + 8.6 + 50.2 + 86.1 + 12.9 = ?

6. Subtract 26.85 from 60.42.

7. How much must be added to 62.5 in. to make 72 in.?

8. An electric train regularly priced at $24.75 was put on sale at $\frac{1}{5}$ off. What was the sale price of the train?

9. From Oceanside to Sandy Beach is 24.7 mi. by the shore road and 31.3 mi. by the inland route. How much shorter is the distance by way of the shore road?

10. Find the average of 174 and 185 and 211.

Just for fun

1. Here is a good puzzle:

Bill: What is your favorite number, Jack?
Jack: Seven. Why?
Bill: Just do this multiplication:→

12345679
× 63

Jack was amazed at the answer.

Would you like to try the puzzle on someone yourself? This is how:

- Ask the person his favorite number (under 10).
- Write 1 2 3 4 5 6 7 9 (skip 8).
- Under this large number write 9 times his favorite number.
- Tell him to multiply and see what he gets.

2. Ross says he can arrange eight 4's so that the sum is equal to 500. He has written five of the 4's as shown in the box. Where shall he write the other three 4's?

44
444

Estimating products

1. The length of a United States flag should be 1.9 times its width. If a flag is to be 24 inches wide, its length should be 1.9 × 24 inches.

To find the length, Tom multiplied 24 in. by 1.9, as in Box A. Why is the work not complete?

A

$$\begin{array}{r} 24 \text{ in.} \\ \underline{1.9} \\ 216 \\ \underline{24} \\ 456 \text{ in.} \end{array}$$

(not finished)

2. Tom said, "I know that 1.9 × 24 is a little less than 2 × 24, or 48; so the decimal point should come between the 5 and the 6. The answer is 45.6 in." Was he right?

3. A U.S. flag 36 inches wide should be 1.9 × 36 in. long, or a little less than _?_ inches long. Where would you put the decimal point in the product in Box B?

B

$$\begin{array}{r} 36 \text{ in.} \\ \underline{1.9} \\ 324 \\ \underline{36} \\ 684 \text{ in.} \end{array}$$

(not finished)

4. Find the correct lengths of U.S. flags with widths of 10 in.; 16 in.; 40 in.; 2 ft. 3 in.; 1 ft. 8 in.

5. Don estimated that the weight of 4.5 gallons of oil, weighing 7.5 lb. a gallon, is between 28 lb. and 40 lb. Is his estimate sensible?

6. Don multiplied 7.5 lb. by 4.5, as shown in Box C. Tell where to place the decimal point.

C

$$\begin{array}{r} 7.5 \text{ lb.} \\ \underline{4.5} \\ 375 \\ \underline{300} \\ 3375 \text{ lb.} \end{array}$$

(not finished)

7. Is 2.5 × 3.87 more than 2 × 3? Is it less than 3 × 4? Can you make a better estimate?

8. To find 2.5 × 3.87, Jane multiplied as shown in Box D. Where should the decimal point be placed?

D

$$\begin{array}{r} 3.87 \\ \underline{2.5} \\ 1935 \\ \underline{774} \\ 9675 \end{array}$$

(not finished)

Estimate to find where to place the decimal points:

9.
$$\begin{array}{r} 12.05 \\ \underline{\times 4} \\ 4820 \end{array}$$

10.
$$\begin{array}{r} 12.05 \\ \underline{\times 4.1} \\ 1205 \\ \underline{4820} \\ 49405 \end{array}$$

11.
$$\begin{array}{r} 3.97 \\ \underline{\times 2.1} \\ 397 \\ \underline{794} \\ 8337 \end{array}$$

12.
$$\begin{array}{r} 4.03 \\ \underline{\times 2.4} \\ 1612 \\ \underline{806} \\ 9672 \end{array}$$

13.
$$\begin{array}{r} 7.08 \\ \underline{\times 1.1} \\ 708 \\ \underline{708} \\ 7788 \end{array}$$

Multiplying decimals

1. To find .5 × 4.3, this is what some pupils did:

JANE: $.5 \times 4.3$ is $\frac{1}{2} \times 4.3$ I estimate the answer to be about 2.

FRED: $.5 \times 4.3 = \frac{5}{10} \times 4\frac{3}{10} = \frac{5}{10} \times \frac{43}{10} = \frac{215}{100} = 2\frac{15}{100}$

SUE:
$$\begin{array}{r l} 4.3 & \\ \times\ .5 & \text{2 decimal places} \\ \hline 2.15 & \text{2 decimal places} \end{array}$$

Do the answers agree? Can you tell how Sue knew where to place the decimal point in the answer? Whose way is easier, Fred's or Sue's?

Estimate answers to see if decimal points are placed correctly:

2.
$$\begin{array}{r l} 41.2 & \text{1 decimal place} \\ 12 & \\ \hline 824 & \\ 412 & \\ \hline 494.4 & \text{1 decimal place} \end{array}$$

3.
$$\begin{array}{r l} 32.7 & \text{2 decimal places} \\ 1.2 & \\ \hline 654 & \\ 327 & \\ \hline 39.24 & \text{2 decimal places} \end{array}$$

4.
$$\begin{array}{r l} 2.98 & \text{3 decimal places} \\ 1.2 & \\ \hline 596 & \\ 298 & \\ \hline 3.576 & \text{3 decimal places} \end{array}$$

Make a rule for placing the decimal point in the answer when you multiply numbers containing decimals.

5. Estimate to see whether the decimal point is placed correctly in these products. Then see whether your rule works.

$2.5 \times 27 = 67.5$ $4.3 \times 2.9 = 12.47$ $.9 \times 3.62 = 3.258$

> **In multiplication of decimals, there should be as many decimal places in the product as there are decimal places in the multiplicand and the multiplier together.**

6. Find the *mistakes* in these examples:

$$\begin{array}{r} 584.7 \\ 5.7 \\ \hline 40929 \\ 29235 \\ \hline 33327.9 \end{array} \qquad \begin{array}{r} 90.6 \\ .35 \\ \hline 4530 \\ 2718 \\ \hline 317.10 \end{array} \qquad \begin{array}{r} 7.89 \\ 40.6 \\ \hline 4734 \\ 3156 \\ \hline 36.294 \end{array} \qquad \begin{array}{r} 406 \\ .028 \\ \hline 3248 \\ 812 \\ \hline 113.68 \end{array}$$

7. Estimate each product. Then check by multiplying.

5×2.1 20×4.02 8.89×9 $.5 \times 40$ 67.4×2.1

8. Bob learned in science class that a gallon of water weighs 8.36 lb. Then he found this table:

Gasoline	.67 × as heavy as water
Castor oil	.97 × as heavy as water
Milk	1.03 × as heavy as water
Turpentine	.87 × as heavy as water
Lard	.92 × as heavy as water

Bob said, "It's easy to see from the table that a gallon of milk is a little heavier than a gallon of water." Explain.

9. Using the table in Ex. 8, estimate the weight of a gallon of milk. Then compute the weight.

10. How can you tell from the table that a gallon of gasoline, castor oil, turpentine, or lard weighs less than a gallon of water?

11. Estimate the weight of a gallon of gasoline, castor oil, turpentine, and lard. Then compute the weight of each.

12. Which of the five things in the table will float if you put them in water? Does that prove they are heavier or lighter than water?

13. An empty 10-gallon tank weighs 16.4 lb. How much does it weigh when filled with water? (A gallon of water weighs 8.36 lb.)

Tell how many decimal places there will be in each answer. Multiply and check. Be sure each answer is reasonable.

	a	*b*	*c*	*d*
14.	$.8 \times 6.2$	$68 \times .45$	75.6×43.5	5.6×98.4
15.	$2.7 \times .42$	9×3.562	$.8 \times 1.17$	68.5×6.03
16.	$.85 \times 60.8$	78.5×40.5	$.79 \times .4$	20×2.2
17.	40×7.465	8×65.74	$20 \times .2$	20×22.2

18. Miss Carter's class had a contest to see in how many different ways they could find 3×4.25.

Explain the ways they used, as shown below. Can you think of any other ways?

JOHN

$$\begin{array}{r} 4.25 \\ 4.25 \\ \underline{4.25} \\ 12.75 \end{array}$$

PETER

$$3 \times 4\tfrac{1}{4} = 3 \times \tfrac{17}{4} = \tfrac{51}{4} = 12\tfrac{3}{4}$$

CHARLES

$$\begin{array}{r} 4.25 \\ \underline{\times 3} \\ 12.75 \end{array}$$

Multiplying decimals

▶ When Joan needed to multiply .15 by .3, the first thing she did was to multiply 15 by 3. Her work looked like this: →

$$\begin{array}{r} .15 \\ \underline{.3} \\ 4\,5 \end{array}$$

(not finished)

Then she thought, "There are two decimal places in the multiplicand and one in the multiplier. I must *point off*, or place the decimal point, so that there are three decimal places in the answer."

Joan could not point off three places in the product when there were only two figures. What would you have done?

▶ Joan thought, "I'll change the decimals to common fractions and multiply to find the answer."

She wrote: $.15 = \frac{15}{100}$; $.3 = \frac{3}{10}$; therefore $\frac{15}{100} \times \frac{3}{10} = \frac{45}{1000}$.

Then Joan knew her answer should be $\frac{45}{1000}$; so she put a 0 to the left of the 45 in her answer. (She *prefixed* one zero.)

Then Joan could point off the three places. See her answer. →

$$\begin{array}{r} .15 \\ \underline{.3} \\ .045 \end{array}$$

▶ To find $.3 \times .2$, Joan did this multiplication:

$$\frac{3}{10} \times \frac{2}{10}.$$

Did she find that the product was .60, or .06?

1. $\frac{3}{10} \times \frac{3}{10} = \frac{?}{100}$; then does $.3 \times .3 = .9$ or .09?

2. $\frac{2}{10} \times \frac{33}{100} = \frac{?}{1000}$; then does $.2 \times .33 = .66$ or .066?

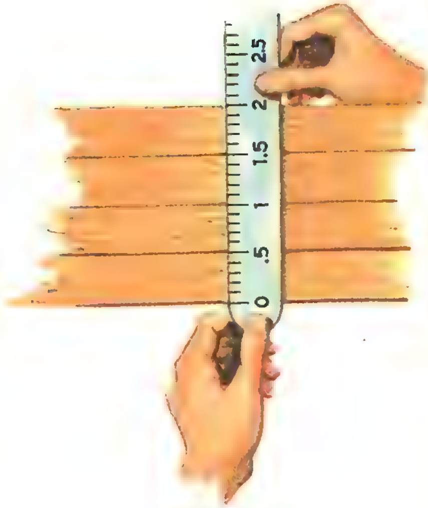
3. $\frac{4}{100} \times \frac{2}{10} = \frac{?}{?}$; then does $.04 \times .2 = .8$, or .08, or .008?

4. Show how the rule below works in Exs. 1–3.

> **When there are more decimal places to be pointed off than there are figures in the product, write zeros to the left of the product to make the required number of decimal places.**

5. Multiply. Use common fractions to check each answer.

a	*b*	*c*	*d*	*e*	*f*
.2	.04	.004	.16	.013	.8
.2	.3	6	.6	5	.04



1. Joe put together 4 boards, each .5 inch thick, to make an aquaplane. His aquaplane was _?_ inches thick.

2. How many miles does a bus travel in making 4 round trips between two towns 36.8 mi. apart?

3. Bill's father's car goes 15.75 mi. on 1 gal. of gasoline. How far can it travel on 4.5 gal.?

4. Find the cost of 13.8 ft. of copper tubing at $18\frac{1}{2}$¢ (\$.185) a foot.

5. The flying cost of a plane was given as \$.50$\frac{7}{10}$ (\$.507) a mile. Find the cost of a 75-mile flight.

6. A rectangle is $4.5' \times 2.7'$. Find its area; its perimeter.

7. How much will a 54-mile railroad trip cost at \$.026 a mile?

Tell how many decimal places there will be in each product. Multiply. Then read each answer. Be sure it is sensible.

	a	b	c	d	e
8.	256 4.06	57.4 5.8	65.5 .48	8.92 19	25.9 10
9.	65.8 3.9	.98 9	786 .05	80.8 .75	4.86 200
10.	.408 46	305.7 .01	.079 64	563.4 5.79	5.95 2400

Practice with decimals

In Exs. 1–8, first tell how many decimal places to point off in each product. Then copy and multiply. Check by going over your work.

	a	*b*	*c*	*d*
1.	$.4 \times .22$	$.5 \times .19$	$9 \times .001$	$.14 \times 5$
2.	$6 \times .012$	$1.8 \times .05$	$4 \times .02$	$2.4 \times .04$
3.	4.3×1.86	$.9 \times 5.64$	$.16 \times .5$	5.4×98.2
4.	$5.6 \times .06$	76×3.78	$.003 \times 18$	5.08×934
5.	88×6.75	1.57×508	$1.9 \times .04$	$2.3 \times .03$
6.	$.28 \times 5$	$.76 \times 36.9$	$.43 \times 1.8$	$.8 \times .96$
7.	3.5×4.85	80.4×45.9	8.9×65.8	35.8×75.6
8.	$.37 \times 75.4$	$.4 \times .21$	$.48 \times 5.3$	$.049 \times 40$

Change to proper fractions or mixed numbers:

9. .6 .75 4.6 .025 .80 2.15 9.05 5.9 3.8 .45

Add and check:

10. $6.8 + 5.06 + 8.79 + 45.05$

11. $4.65 + 6.089 + 9.78 + 1.679$

12. $.48 + .624 + .076 + 19.862$

13. $8.055 + 17.74 + .08 + 4.07$

Subtract and check:

	a	*b*	*c*	*d*	*e*
14.	45.6 26.8	26.42 9.76	56.86 5.89	80.050 7.682	75.59 4.99
15.	85.06 29.57	32.47 .68	60.06 1.88	17.01 9.69	92.402 7.806

16. Subtract 6.4 from 8.2; 2.98 from 11.35.

17. 3.55 and how many more make 5.4?

Helpful short cuts

1. One thousand hours of labor are needed to construct a small airplane.

Which multiplication below shows the cost of 10 hr. of labor at \$1.25 an hour? of 100 hr. of labor? of 1000 hr.?

$$\begin{array}{r} \$1.25 \\ 10 \\ \hline \$12.50 \end{array} \qquad \begin{array}{r} \$1.25 \\ 100 \\ \hline \$125.00 \end{array} \qquad \begin{array}{r} \$1.25 \\ 1000 \\ \hline \$1250.00 \end{array}$$

2. Multiplying \$1.25 by 10 moves the decimal point _?_ place to the right.

3. Multiplying \$1.25 by 100 moves the decimal point _?_ places to the right.

4. Multiplying \$1.25 by 1000 moves the decimal point _?_ places to the right.

5. Explain how the decimal point is moved in each of these multiplications:

$$\begin{aligned} 10 \times 6.375 &= 63.75 \\ 100 \times 6.375 &= 637.5 \\ 1000 \times 6.375 &= 6375. \\ 10 \times 637.5 &= 6375. \\ 100 \times 637.5 &= 63750. \\ 1000 \times 637.5 &= 637500. \end{aligned}$$

6. To multiply 637.5 by 100, do you annex a zero? To multiply 637.5 by 1000, you annex _?_ zeros.

To multiply a decimal:

- **by 10, move the decimal point 1 place to the right.**
- **by 100, move the decimal point 2 places to the right.**
- **by 1000, move the decimal point 3 places to the right.**

7. Multiply .864 by 10; by 100; by 1000.

8. Multiply 93.2 by 10; by 100; by 1000.

9. Carl was looking at the rules for multiplying a decimal by 10, by 100, or by 1000.

He said, "Those same rules work when multiplying a whole number by 10, by 100, or by 1000."

How does $10 \times 48 = 480$ show that Carl is right? Give other illustrations of what he means.

10. Write an addition example using 4.9 as an addend 10 times. Find the sum.

The addition you just did proves that 10×4.9 is _?_.

11. If you did an addition using 4.9 as an addend 100 times, the sum would be _?_.

12. Which is more: 10×5.6, or 53? Then would you say that $53 \div 5.6$ is more or less than 10?

No pencils, please!

Multiply each number orally by 10; by 100; by 1000:

	a	b	c	d	e	f
1.	6.254	64.86	18.6	.016	6.035	94.08
2.	48.083	2.98	.86	68	242.8	208.4
3.	1.098	8	33	.9	.008	.504

Do not use a pencil for these problems:

4. In one pound of milk there will be .871 pound of water.

What is the weight of the water in 10 lb. of milk? in 100 lb.?

5. .111 of the weight of a pound of apples is sugar. How many pounds of sugar are there in 10 lb. of apples? in 100 lb.?

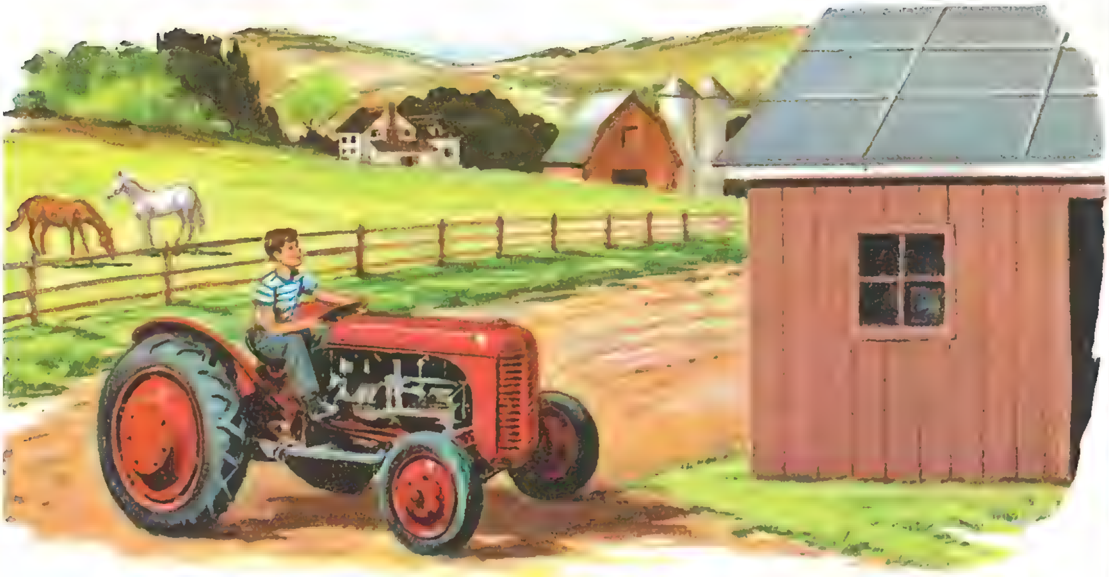
6. At $.012 a pound, what is the freight charge for a bag of lime weighing 100 lb.?

7. Bone meal sells at $2.40 for a 10-pound bag. How much will 100 lb. cost?

8. At $.026 a mile, how much will a bus ticket for a 100-mile trip cost?

9. In sheets of 100 stamps, how much will a sheet of 3-cent stamps cost? of 5-cent stamps?

10. Look at the picture. Ted's father got $.44 change from $3.00 after buying 10 gal. of gasoline. Was his change correct?



Problem-solving help

Tell what you need to know and to do to solve each problem.

1. Kenneth wants to find how much paint he needs to paint the roof of the shed in the picture.

2. Pauline wants to find how much she can save by making a pair of slacks herself instead of buying a ready-made pair.

3. Joe wants to find how much he can earn each week by selling magazines.

4. Tom wants to find the cost of ice cream for a party.

5. Peter wants to find how much he can earn by buying peanut bars by the dozen and selling them for a nickel apiece.

6. Louise wants to find her average mark in arithmetic tests.

7. Albert wants to find how great a distance is represented by a certain line on a scale drawing.

8. Larry wants to find what part of his class is boys.

9. Roy wants to find how much money he can earn by selling the berries he has just picked.

10. Charles wants to find how much he should charge Don for 1 doughnut out of a package.

11. Alice wants to find how many yards of ribbon to buy to make an arm band for each pupil.

12. Jane wants to find how much she can save by buying a large box of cocoa instead of buying the same amount in small boxes.

Finding a decimal part of a number

1. Does $\frac{1}{2}$ of 64 mean $\frac{1}{2} \times 64$?

2. Does $\frac{4}{10}$ of 80 mean $\frac{4}{10} \times 80$?

3. Does $\frac{17}{100}$ of 75 mean $\frac{17}{100} \times 75$?

4. Does .4 of 80 mean $.4 \times 80$?

5. Does .17 of 75 mean $.17 \times 75$?

6. $\frac{7}{10}$ of 30 = _?_ .7 of 30 = _?_

Make up a rule for finding .7 of a number.

7. $\frac{17}{100}$ of 75 = _?_ .17 of 75 = _?_

Make up a rule for finding .17 of a number.

Find:

8. $\frac{6}{10}$ of 32; .6 of 32

9. $\frac{9}{10}$ of 78; .9 of 78

10. $\frac{13}{100}$ of 25; .13 of 25

11. $\frac{38}{100}$ of 60; .38 of 60

12. If .6 of the 30 pupils in a class were absent on a stormy day, how many pupils were absent?

13. After James read Ex. 12, he said, "Then only .4 of the 30 pupils were present."

In how many ways can you prove that James was right?

If .6 of the pupils were absent, were more than half absent?

14. A baseball team played 15 games. It won .8 of the games. How many did it win? lose?

15. A city newspaper report said that .60 of the children in the city had eye defects.

There were 12,745 pupils in the schools in that city. How many had eye defects?

16. If .97 of the pupils in a sixth-grade class earned money for the Junior Red Cross, could you say that nearly all the pupils earned money for the Junior Red Cross? Explain.

17. Do these statements mean the same? Explain.

- .52 of the pupils in Longfellow School are boys.
- A little over half of the pupils in Longfellow School are boys.

Find:

	a	*b*
18.	.7 of 64	.9 of 182
19.	.6 of 117	.8 of 46
20.	.72 of 180	.95 of 74
21.	.87 of 475	.25 of 482
22.	.75 of 38	.62 of 385
23.	.10 of 75	.90 of 246

Common fraction review

Reduce these fractions to lowest terms:

	a	b	c	d	e	f	g	h	i	j
1.	$\frac{10}{12}$	$\frac{10}{16}$	$\frac{6}{18}$	$\frac{12}{20}$	$\frac{5}{15}$	$\frac{18}{24}$	$\frac{6}{16}$	$\frac{40}{100}$	$\frac{16}{20}$	$\frac{25}{100}$

Change to mixed numbers:

2.	$\frac{11}{6}$	$\frac{19}{4}$	$\frac{27}{7}$	$\frac{45}{8}$	$\frac{35}{4}$	$\frac{19}{3}$	$\frac{55}{9}$	$\frac{55}{8}$	$\frac{55}{6}$	$\frac{73}{9}$

Change to mixed numbers, and reduce fractions to lowest terms:

3.	$\frac{20}{8}$	$\frac{36}{16}$	$\frac{42}{10}$	$\frac{21}{12}$	$\frac{50}{6}$	$\frac{75}{9}$	$\frac{60}{8}$	$\frac{58}{6}$	$\frac{30}{4}$	$\frac{50}{20}$

Supply the missing numerators:

	a	b	c	d	e
4.	$\frac{4}{5} = \frac{?}{10}$	$\frac{7}{8} = \frac{?}{24}$	$\frac{3}{4} = \frac{?}{16}$	$\frac{1}{6} = \frac{?}{24}$	$\frac{7}{10} = \frac{?}{20}$
5.	$\frac{5}{6} = \frac{?}{18}$	$\frac{2}{3} = \frac{?}{12}$	$\frac{3}{5} = \frac{?}{20}$	$\frac{3}{4} = \frac{?}{24}$	$\frac{2}{3} = \frac{?}{15}$

Add; then check by going over your work:

6.	$1\frac{3}{4}$	$3\frac{1}{2}$	$\frac{7}{8}$	$3\frac{2}{5}$	$8\frac{5}{12}$
	$\frac{1}{2}$	$5\frac{2}{5}$	$\frac{3}{4}$	6	$5\frac{3}{4}$
	$1\frac{1}{8}$	$\frac{9}{10}$	$\frac{5}{16}$	$4\frac{1}{4}$	$3\frac{1}{3}$

Subtract; then check by going over your work:

7.	$4\frac{2}{3}$	$4\frac{3}{10}$	$5\frac{5}{16}$	$3\frac{2}{3}$	12
	$1\frac{1}{12}$	$\frac{4}{5}$	$1\frac{3}{8}$	$1\frac{1}{4}$	$2\frac{5}{6}$

Multiply. Be sure to check your work.

8.	$\frac{5}{6} \times 24$	$2\frac{5}{8} \times 2\frac{1}{3}$	$3\frac{1}{2} \times \frac{2}{3}$	$\frac{5}{6} \times \frac{5}{8}$	$3 \times 3\frac{1}{3}$
9.	$\frac{3}{4} \times 2\frac{1}{2}$	$30 \times \frac{4}{5}$	$8 \times 2\frac{1}{4}$	$\frac{2}{5} \times 3\frac{3}{4}$	$5\frac{1}{4} \times 4\frac{2}{3}$

Divide; then check your work.

10.	$6 \div \frac{1}{3}$	$\frac{5}{6} \div 5$	$9 \div \frac{1}{3}$	$\frac{9}{10} \div \frac{2}{5}$	$12 \div 1\frac{1}{4}$
11.	$5 \div \frac{2}{3}$	$20 \div \frac{5}{6}$	$\frac{9}{10} \div \frac{1}{2}$	$2\frac{1}{4} \div \frac{4}{3}$	$\frac{5}{12} \div 1\frac{1}{4}$
12.	$\frac{7}{8} \div 7$	$4\frac{1}{2} \div 3$	$5\frac{1}{4} \div \frac{3}{2}$	$10 \div \frac{1}{4}$	$8\frac{1}{3} \div \frac{2}{3}$

A page of problems

1. At 60¢ a pound, find the cost of 12 oz. of meat.

2. How long will it take to travel 180 miles if you move at the rate of 45 miles an hour?

3. There are 204 sixth-grade pupils going to the museum. Each bus holds 34 pupils. How many buses will be needed?

4. Molly needs $1\frac{1}{2}$ lb. of popcorn for a party. The popcorn comes in bags holding $\frac{1}{4}$ lb. How many bags should Molly buy?

5. At the start of an automobile trip, a speedometer showed 1567.9 miles. At the end it showed 2004.3. How many miles had the car traveled on the trip?

6. Find the area of a rectangle that measures 4.5′ by 6.3′.

7. Find the sum of 12.4, 16.2, 25.3, 16.7, and 18.2.

8. Ann's father is paid twice a month. Every payday Ann gets an allowance of $.75. How much does she get in a year?

9. Don makes 4 pinwheels out of 3 sheets of paper. What part of a sheet does he use for each pinwheel?

10. Grace's cooky recipe calls for 4 cups of flour. She has only $2\frac{3}{4}$ cups of flour. How much more flour does she need?

11. How much will fencing for a playground cost at 50¢ a foot if the playground is $60\frac{1}{2}$ ft. long and $48\frac{2}{3}$ ft. wide?

12. Find the cost of 24 inches of gingham at 39¢ a yard.

13. If $\frac{1}{8}$ inch on a map represents a mile, how many miles are represented by a line $\frac{3}{4}$ in. long?

14. At 4 for 25¢, find the cost of 8 pears; of 12; of 16; 5; 6.

15. If you travel 195 miles in $6\frac{1}{2}$ hours, you are going at the rate of _?_ miles an hour.

16. If you can do 4 arithmetic examples in 5 minutes, at the same rate how long will it take you to do 20 examples?

17. In one year 46.40 inches of rain fell in New York. The next year 35.69 inches of rain fell.
What was the difference in rainfall in those two years?

18. Which of the following might be the length of Bob's canoe? 1.35′ 13.5′ 135′ 162″

For those who like to think

Tell whether these statements are always true. Defend your answers.

Easy exercises

1. A mixed number is larger than one.

2. The sum of two fractions is a fraction.

3. The sum is greater than any of its addends.

4. The difference plus the subtrahend equals the minuend.

5. The minuend minus the difference equals the subtrahend.

6. A four-digit number is at least one larger than any three-digit number.

7. The decimal point separates a whole number and a fraction.

8. Annexing a zero to a whole number multiplies it by 10.

9. Dropping a final zero from a number divides it by 10.

10. Two groups of tens may be regrouped into hundreds and tens.

Harder exercises

1. A fraction is less than one.

2. A whole number is greater than a fraction.

3. The product of a whole number and a fraction is greater than one.

4. The product of two fractions is a fraction.

5. If multiplier and multiplicand are decimals, the product is smaller than either.

6. If the divisor is a decimal, the quotient will be larger than the dividend.

7. If a dividend and its divisor are multiplied by 10, the quotient becomes 10 times as great.

8. A dividend is larger than its divisor.

9. The quotient is larger than the dividend when the divisor is smaller than one.

10. You can find a missing multiplier by dividing the product by the multiplicand.

11. The divisor is equal to the quotient divided by the dividend.

12. Doubling the multiplier and multiplicand doubles the product.

13. Doubling the dividend and the divisor doubles the quotient.

UNIT 27

Dividing decimals. Dividing by 10, by 100, by 1000. Nearest tenths and hundredths

Dividing a decimal by a whole number

A

$$84\tfrac{8}{10} \div 2 =$$

$$\frac{848}{10} \div \frac{2}{1} =$$

$$\frac{\overset{424}{\cancel{848}}}{10} \times \frac{1}{\cancel{2}} = 42\tfrac{4}{10}$$

B

$$\begin{array}{r} 4\,2\,4 \\ 2\overline{)8\,4.8} \end{array}$$

(not finished)

1. The Martin family drove from Oil City to Crooked Gulch in 2 hours. The picture map showed the distance was ? miles.

2. Would you estimate their rate of driving to be about 24 mi. an hour, about 42 mi. an hour, or about 424 mi. an hour?

3. To find their rate of driving, you need to divide 84.8 by 2. One way to do the division is to change the 84.8 to $84\frac{8}{10}$. Explain the division in Box A. The rate of driving was ? mi. an hour.

4. A better way to divide 84.8 by 2 is shown in Box B. Where should you place the decimal point to make the answer sensible?
Do the answers to the two divisions agree?

Where should you place the decimal point in these quotients to make the answers sensible? Tell why. Read each answer.

5. $\begin{array}{r} 3\,2 \\ 3\overline{)9.6} \end{array}$ $\quad\begin{array}{r} 1\,2\,5 \\ 7\overline{)8.7\,5} \end{array}$ $\quad\begin{array}{r} 1\,6\,4 \\ 6\overline{)9\,8.4} \end{array}$ $\quad\begin{array}{r} 2\,1 \\ 9\overline{)1.8\,9} \end{array}$ $\quad\begin{array}{r} 2\,4\,3 \\ 76\overline{)1\,8.4\,6\,8} \end{array}$

6. $\begin{array}{r} 3\,2 \\ 6\overline{)1\,9.2} \end{array}$ $\quad\begin{array}{r} 5\,9\,4 \\ 8\overline{)4\,7.5\,2} \end{array}$ $\quad\begin{array}{r} 1\,9\,5 \\ 47\overline{)9\,1.6\,5} \end{array}$ $\quad\begin{array}{r} 2\,0 \\ 56\overline{)1\,1.2\,0} \end{array}$ $\quad\begin{array}{r} 1\,0\,7 \\ 29\overline{)3.1\,0\,3} \end{array}$

In dividing a decimal by a whole number, place the decimal point in the quotient right above the point in the dividend.

Practice in dividing decimals

Do the divisions below. Be careful to place the decimal point correctly in each quotient.

1.	$7\overline{)66.71}$	$6\overline{)404.4}$	$9\overline{)3.825}$	$8\overline{)37.92}$	$7\overline{)2.576}$
2.	$79\overline{)2725.5}$	$43\overline{)88.15}$	$86\overline{)420.54}$	$95\overline{)35.15}$	$28\overline{)3.640}$
3.	$23\overline{)20.47}$	$57\overline{)18.24}$	$48\overline{)460.8}$	$76\overline{)288.8}$	$55\overline{)467.5}$

4. Bob has a copper pipe 15.6 ft. long. He wants to cut it into 6 equal pieces. How long will each piece be?

5. How many 8-inch pieces of lead pipe can you cut from a pipe 76.8 in. long?

6. If 5.8 in. of rain falls in 2 days, it falls at a rate of _?_ in. a day.

7. A river rose 6.4 ft. in 4 hr. It rose at the rate of _?_ ft. an hour.

8. A runner ran 101.7 ft. in 5 sec. He ran at the rate of _?_ ft. a second.

9. An airplane used 103.6 gal. of gasoline in 7 hr. of flight. It used gasoline at the rate of _?_ gal. an hour.

10. $\frac{8}{10} = \frac{8 \div 2}{10 \div 2} = \frac{?}{?}$ $\qquad \frac{4}{5} = \frac{2 \times 4}{2 \times 5} = \frac{?}{?}$

11. In Ex. 10 the fraction $\frac{8}{10}$ is reduced by dividing both the numerator and denominator by _?_.

12. In Ex. 10 the fraction $\frac{4}{5}$ is changed back to $\frac{8}{10}$ by multiplying both the numerator and denominator by _?_.

13. To change $\frac{3}{5}$ to $\frac{30}{50}$, you multiply the numerator and denominator by _?_.

14. To change $\frac{.3}{.5}$ to $\frac{3}{5}$, you multiply both numerator and denominator by _?_.

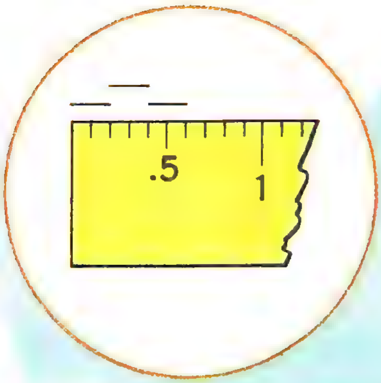
15. To change $\frac{.48}{.12}$ to $\frac{48}{12}$, you multiply both numerator and denominator by _?_

16. One meaning of the fraction $\frac{7}{10}$ is $7 \div 10$. The 7 is the dividend; the 10 is the _?_.

17. Name the dividend and the divisor in these: $\frac{4}{5}$ $\quad \frac{9}{15}$ $\quad \frac{8}{5}$

Which part does not have the same value as the other four parts?

18.	$6\overline{)5}$	$\frac{5}{6}$	$\frac{50}{60}$	$\frac{500}{600}$	$\frac{6}{5}$
19.	$7\overline{)3}$	$\frac{7}{3}$	$\frac{30}{70}$	$70\overline{)30}$	$\frac{3}{7}$



Dividing by a decimal

1. When Helen carries her new camera, it slips around in the old case she uses. She needs a pad of felt .6 inch thick to put in the case.

She has some felt .2 inch thick. To find how many layers of felt to put together for a pad .6 inch thick, she must find how many .2 inches there are in .6 inch.

① Tom used a ruler to show that there are _?_ .2 inches in .6 inch.

② Jane found how many .2's there are in .6 this way:

$$.2 = \frac{2}{10} \qquad .6 = \frac{6}{10}$$

$$\frac{6}{10} \div \frac{2}{10} = \frac{\cancel{6}^{\,3}}{\cancel{10}_{\,1}} \times \frac{\cancel{10}^{\,1}}{\cancel{2}_{\,1}} = \underline{?}$$

③ Peter wrote this:

$$.2\overline{).6} = \frac{.6}{.2} = \frac{10 \times .6}{10 \times .2} = \frac{6}{2} = 2\overline{)6}^{\;?}$$

Why do you think Peter multiplied the numerator and denominator of $\frac{.6}{.2}$ by 10?

2. Did Tom, Jane, and Peter all get the same answer?

3. Use Tom's, Jane's, and Peter's method to find:

$$.2\overline{).8} \qquad .3\overline{).9} \qquad .4\overline{).8}$$

4. Polly needed to divide 15.12 by 4.2.

She had never learned how to divide *by a decimal,* but she did know how to divide a decimal *by a whole number;* so she changed the divisor 4.2 to a whole number.

This is how Polly did the division. Can you explain her work?

$$4.2\overline{)15.12} = \frac{15.12}{4.2} = \frac{10 \times 15.12}{10 \times 4.2} = \frac{151.2}{42} = \begin{array}{r} 3.6 \\ 42\overline{)151.2} \\ \underline{126} \\ 25\,2 \\ \underline{25\,2} \end{array}$$

Notice that the divisor 4.2 is changed to a whole number.

5. To change the 4.2 into the whole number 42 (Ex. 4), Polly multiplied 4.2 by _?_.

6. Tell why Polly also multiplied 15.12 by 10.

7. Polly's division shows that $15.12 \div 3.6 =$ _?_.

Is that a reasonable answer?

Check: Does $3.6 \times 4.2 = 15.12$?

8. Polly could have done her work this way: $4_\wedge 2.\overline{)15_\wedge 1.2}$

The $4_\wedge 2.$ shows that 4.2 has been multiplied by 10.

The $15_\wedge 1.2$ shows that 15.12 has also been multiplied by _?_.

The $4_\wedge 2.\overline{)15_\wedge 1.2}$ means $42\overline{)151.2}$

9. In doing the division $2.5\overline{)7.5}$, Tom thought:

STEP 1. $2.5\overline{)7.5} = \dfrac{7.5}{2.5}$

STEP 2. $\dfrac{10 \times 7.5}{10 \times 2.5} = \dfrac{75}{25}$

STEP 3. $\dfrac{75}{25} = \begin{array}{r} 3 \\ 25\overline{)75} \end{array}$

Explain Step 1 in Tom's thinking above.

Tom did Step 2 because he wanted to make 2.5, which is the divisor or denominator, into a whole number. Explain Step 2.

Explain Step 3.

10. In doing the division $.4\overline{).24}$, Tom took these steps. Explain each step.

STEP 1. $.4\overline{).24} = \dfrac{.24}{.4}$

STEP 2. $\dfrac{10 \times .24}{10 \times .4} = \dfrac{2.4}{4}$

STEP 3. $\begin{array}{r} .6 \\ 4\overline{)2.4} \end{array}$

11. Explain each step in doing this division: $.25\overline{).125}$

STEP 1. $.25\overline{).125} = \dfrac{.125}{.25}$

STEP 2. $\dfrac{100 \times .125}{100 \times .25} = \dfrac{12.5}{25}$

STEP 3. $\begin{array}{r} .5 \\ 25\overline{)12.5} \end{array}$

12. Explain each step in doing this division: $.17\overline{).085}$

STEP 1. $.17\overline{).085} = \dfrac{.085}{.17}$

STEP 2. $\dfrac{100 \times .085}{100 \times .17} = \dfrac{8.5}{17}$

STEP 3. $\begin{array}{r} .5 \\ 17\overline{)8.5} \end{array}$

13. Tell what each of these decimals should be multiplied by so that it will be changed to a whole number:

.6	3.4	.9	.08	4.5
.16	2.75	.36	.45	12.2

A short cut

1. Here is a short cut to use in dividing by decimals:

▶ In the division $8.64 \div 2.4$, change the divisor to a whole number by multiplying it by 10; that is, by moving the decimal point in the divisor one place to the right.

Make a *caret* (‸) to show the new position of the decimal point.

2.4‸)8.64

▶ Also multiply the dividend by 10; that is, move the decimal point in the dividend also one place to the right.

Make a caret to show the new position of the decimal point.

2.4‸)8.6‸4 (decimal point marked above the quotient)

▶ Put the decimal point in the quotient right above the caret in the dividend.

▶ Now divide. 3.6 is the answer.

```
       3.6
2.4‸)8.6‸4
     7 2
     1 4 4
     1 4 4
```

Is the answer reasonable? Does it check? Does $3.6 \times 2.4 = 8.64$?

2. Can you divide 1.512 by .36?

▶ Make the divisor (.36) a whole number by moving the decimal point _?_ places to the right.

▶ Move the decimal point in the dividend the *same* number of places to the right.

```
         .
.36‸)1.51‸2
```

▶ Put the decimal point in the quotient.

▶ Divide. Check your answer.

```
        4.2
.36‸)1.51‸2
```

3. Divide 9.6 by .016.

▶ Make the divisor (.016) a whole number.

▶ Move the decimal point in the dividend the *same* number of places to the right. Annex enough zeros so that you can do it.

```
              .
.016‸)9.600‸
```

▶ Put the decimal point in the quotient.

▶ Divide. Check your answer.

```
        600.
.016‸)9.600‸
```

Dividing by a Decimal

```
          26.
.32.)8.32.
     6 4
     1 92
     1 92
```

1. Multiply .32 by 100

2. Multiply 8.32 by 100

3. Place decimal point in quotient

4. Divide

Dividing by a decimal

Here is the rule for dividing by a decimal. Show how the rule works in the division at the bottom of page 202.

- **Make the divisor a whole number by moving the decimal point to the right end of the number. (Use a caret.)**

In doing this you are multiplying the divisor by 10, 100, or 1000.

- **Move the decimal point in the dividend as many places to the right as you moved the point in the divisor. (Use a caret.)**

In doing this you are multiplying the dividend by the same number you multiplied the divisor by. Annex zeros if necessary.

- **Put a decimal point for the quotient above the new decimal point in the dividend.**
- **Divide as you do with whole numbers.**

Do not do these divisions. Just copy the examples and place the decimal points where they should be in the quotients.

	a	*b*
1.	$.5\overline{).398}$	$2.5\overline{)4.638}$
2.	$.005\overline{)2.79}$	$.27\overline{)361.8}$
3.	$75.9\overline{)39.86}$	$35\overline{)678.3}$
4.	$.72\overline{)386}$	$.298\overline{)3872}$
5.	$98\overline{)70.56}$	$845\overline{).878}$
6.	$6.4\overline{)6.4}$	$.65\overline{)3.75}$
7.	$6.4\overline{).64}$	$7.3\overline{).645}$
8.	$.64\overline{)6.4}$	$.005\overline{)7.5}$
9.	$.064\overline{)6.4}$	$.75\overline{)75}$
10.	$.64\overline{)64}$	$.84\overline{)35.7}$

In the ***b*** *column below are the examples of the* ***a*** *column with the decimal points placed where they will be in the quotient.*

There are two decimal points placed incorrectly. Find them.

	a	*b*
11.	$8.2\overline{)545.3}$	$8.2_{\wedge}\overline{)545.3_{\wedge}}$
12.	$.75\overline{)36.79}$	$.75_{\wedge}\overline{)36.79_{\wedge}}$
13.	$.043\overline{)35}$	$.043_{\wedge}\overline{)35.000_{\wedge}}$
14.	$.65\overline{)4.355}$	$.65_{\wedge}\overline{)4.35_{\wedge}5}$
15.	$.076\overline{)4.739}$	$.076_{\wedge}\overline{)4.73_{\wedge}9}$
16.	$.38\overline{)24.7}$	$.38_{\wedge}\overline{)24.70_{\wedge}}$
17.	$8.5\overline{)52.484}$	$8.5_{\wedge}\overline{)52.48_{\wedge}4}$

Practice in division of decimals

Divide and check:

	a	*b*	*c*	*d*
1.	7)546.7	9)8.469	.09)276.3	.003)97.38
2.	.4)2.988	.9)81.72	.08)2.584	.7)65.52
3.	.07)52.85	.008)4.544	8)69.76	.004)1696
4.	.15)2.685	.063)2.205	.39)79.95	.015)679.5
5.	3.2)1.888	87)25.23	9.05)2986.5	.26)1.924
6.	.102)4.998	20.8)158.08	8.5)569.5	65)617.5

7. $\frac{1}{2}$ of 8 hundredths = _?_ hundredths

8. $\frac{1}{3}$ of 6 thousandths = _?_ thousandths

9. $\frac{1}{4}$ of 16 hundredths = _?_ hundredths

10. $\frac{1}{5}$ of 105 thousandths = _?_ thousandths

11. Which of these is the division for Ex. 7? Ex. 8? 9? 10?

$$\begin{array}{r} .04 \\ 4\overline{).16} \end{array} \qquad \begin{array}{r} .021 \\ 5\overline{).105} \end{array} \qquad \begin{array}{r} .04 \\ 2\overline{).08} \end{array} \qquad \begin{array}{r} .002 \\ 3\overline{).006} \end{array}$$

12. Would these rules help you do divisions like those in Ex. 11?

- If there is no other figure in tenths place of the quotient, put a zero in that place: → (Why is this a good rule?)

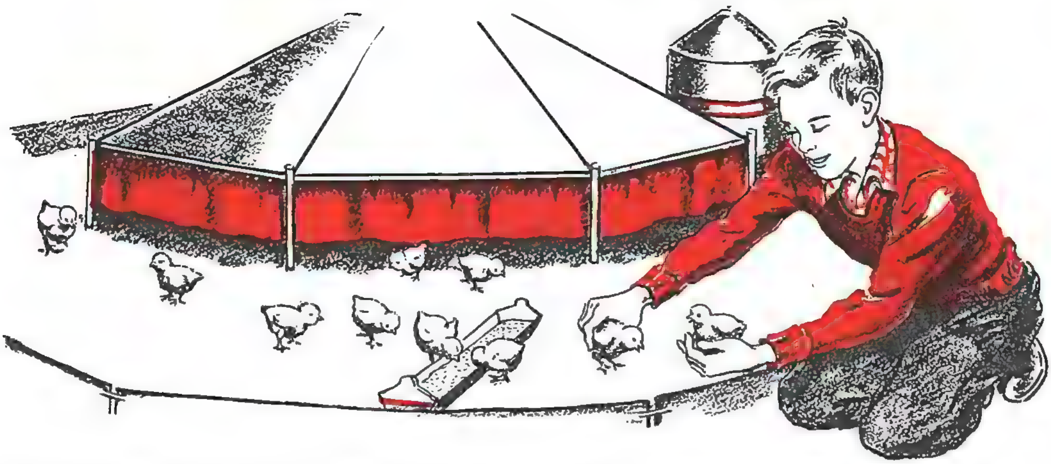
$$\begin{array}{r} .\ \ 54 \\ 2\overline{).108} \end{array} \qquad \begin{array}{r} .054 \\ 2\overline{).108} \end{array}$$

- If there are no other figures in tenths place and hundredths place, put two zeros: → (Why is this a good rule?)

$$\begin{array}{r} .\ \ \ 6 \\ 2\overline{).012} \end{array} \qquad \begin{array}{r} .006 \\ 2\overline{).012} \end{array}$$

Tell how many decimal places there will be in each answer. Then divide and check.

	a	*b*	*c*	*d*	*e*	*f*
13.	.03).27	9).45	7)3.5	.9)27	.5).005	6).54
14.	8)6.4	7).49	.06).84	.6)84	.5)5	.05)12.5



Dividing by 10; by 100; by 1000

Joe saw an advertisement of 100 one-day-old chicks for \$12. To find the cost per chick, he did this division:

$$\begin{array}{r} \$\quad .12 \\ 100\overline{)\$12.00} \\ \underline{100} \\ 200 \\ \underline{200} \end{array}$$

When you divide \$12.00 by 100, the quotient is \$.12.

Notice that the answer \$.12 is the same as \$12 with the decimal point moved two places to the left.

$\$12 \div 100 = \$.12$

1. Divide 3.50 by 10. Is the answer .35?

$$\begin{array}{r} .35 \\ 10\overline{)3.50} \\ \underline{30} \\ 50 \\ \underline{50} \end{array}$$

Notice that the answer .35 is the same as 3.50 with the decimal point moved one place to the left.

$3.50 \div 10 = .350$

2. Divide 1835 by 1000. Your answer should be 1.835. Is that the answer you got?

The answer 1.835 is the same as 1835 with the decimal point moved three places to the left.

$1835 \div 1000 = 1.835$

3. Make a rule for dividing a number by 10; a rule for dividing by 100; by 1000.

To divide a number:
by 10, move the decimal point 1 place to the left.
by 100, move the decimal point 2 places to the left.
by 1000, move the decimal point 3 places to the left.

4. Divide each number by 10:

9.5 4.75 86.5 745 986.4

5. Divide each number by 100:

73.5 4.8 463.5 27 346

6. Divide each number by 1000:

274 8567 2468 753 870

Arithmetic roundup

Oral review

1. When you multiply a number by 10, the number becomes larger. The decimal point moves to the _?_.

2. When you divide a number by 10, the number becomes smaller. The decimal point moves to the _?_.

3. At the rate of 10 mi. an hour, how far can Ben ride his bicycle in $\frac{1}{2}$ hr.? in 2 hr.? $2\frac{1}{2}$ hr.? $4\frac{1}{2}$ hr.?

4. How much is paid by each person when a bill for $12 is shared equally by 6 persons? 4? 3? 2?

5. $\frac{1}{2} = \frac{?}{20}$ $\quad \frac{3}{4} = \frac{?}{20}$ $\quad \frac{7}{10} = \frac{?}{20}$

6. What part of a minute is 10 sec.? 15 sec.? 20? 6? 40?

7. From 6 subtract: $\frac{5}{12}$ $\quad 4\frac{3}{8}$

8. How many tags $\frac{1}{8}$ yd. long can be cut from 1 yd. of tape? from $1\frac{1}{2}$ yd.? from 2 yd.?

9. How much is $6 \times \frac{1}{4}$ yd.? $6 \times \frac{2}{3}$ yd.? $6 \times 1\frac{1}{2}$ yd.?

10. Which is larger, 18.5 or 18.05? .8 or 85? 2.06 or .206?

11. Multiply by 10:
9 $\quad$ 28 $\quad$ .9 $\quad$ .78 $\quad$ 2.8

12. How much will 100 chairs cost at $5.98 each?

Written review

1. Find the sum of these amounts of money:
$505.59 $\quad$ $896.08 $\quad$ $358.75 $\quad$ $647

2. How much must be added to $11.50 to make $15?

3. At 3 for 25¢, how many bulbs can you get for 75¢?

4. How many columns, each $\frac{5}{8}$ in. wide, can you rule on a graph which is 5 in. wide?

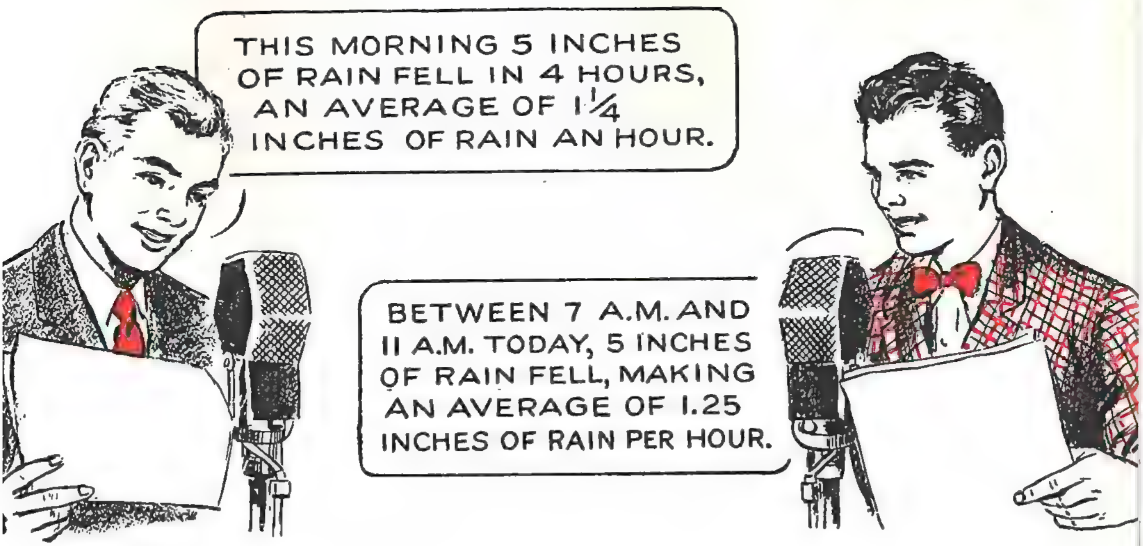
5. Find the cost of 2.8 tons of coal at $13.25 a ton.

6. At the rate of 32.5 mi. an hour, how far can you go in 2.8 hr.?

7. An empty truck weighs 1184.5 lb. When loaded it weighs 1807.2 lb. The load weighs _?_.

8. Write the number which equals 500 million + 500 million.

9. Take the tests on pages 305–308.



Decimals as quotients

Do the two radio announcers agree? Does $1\frac{1}{4}$ in. = 1.25 in.?

Explain these two divisions: $4\overline{)5}$ with quotient $1\frac{1}{4}$ $\qquad$ $4\overline{)5.00}$ with quotient 1.25

When you see that a division example will have a fraction in the quotient, you can place a decimal point after the dividend, write zeros after the decimal point, and go on dividing.

Writing zeros after the decimal point does not change the value of the dividend. $(5.00 = 5\frac{00}{100} = 5)$

Do these divisions. Express quotients in decimal form.

	a	*b*	*c*	*d*
1.	30 ÷ 25	60 ÷ 40	111 ÷ 50	60 ÷ 16
2.	62 ÷ 25	189 ÷ 28	214 ÷ 40	72 ÷ 32
3.	104 ÷ 32	266 ÷ 35	476 ÷ 85	85 ÷ 20
4.	378 ÷ 45	351 ÷ 135	117 ÷ 52	576 ÷ 128
5.	289 ÷ 34	1512 ÷ 288	480 ÷ 64	2255 ÷ 275
6.	216 ÷ 48	135 ÷ 36	837 ÷ 155	2160 ÷ 480
7.	544 ÷ 25	560 ÷ 64	736 ÷ 115	4680 ÷ 624
8.	455 ÷ 52	960 ÷ 384	306 ÷ 72	1316 ÷ 56

Fractions used with decimals

One day in cooking class Miss Cox gave the girls a homework assignment.

She asked each of them to make a soup, keep account of the cost, and then figure out the cost per serving.

The next day Anna said she had spent 18¢ for enough pea soup to serve 8 persons.

Joan said that for 28¢ she made enough bean soup to serve 6 persons.

Anna

$$\begin{array}{r} \$.0225 \\ 8\overline{)\$.1800} \end{array}$$

Joan

$$\begin{array}{r} \$.04666 \\ 6\overline{)\$.28000} \end{array}$$

The girls divided to find the cost per serving. Study their divisions.

1. Did Anna's division come out even? Did Joan's?

Carry Joan's 4 decimal places farther and see what happens.

2. Tom said, "You girls carried your divisions farther than you needed to. Joan's division never would come out even.

"After you have several decimal places in the quotient, you can stop dividing and express the remainder as a fraction."

$$\begin{array}{r} \$.02\tfrac{2}{8} = 2\tfrac{1}{4}¢ \\ 8\overline{)\$.18} \end{array}$$

$$\begin{array}{r} \$.04\tfrac{4}{6} = 4\tfrac{2}{3}¢ \\ 6\overline{)\$.28} \end{array}$$

How much did each serving of Anna's soup cost? of Joan's?

Carry each quotient to two decimal places; then express the remainder as a fraction:

	a	*b*	*c*	*d*	*e*
3.	$6\overline{)\$.15}$	$5\overline{)\$.17}$	$4\overline{)\$.22}$	$8\overline{)\$.54}$	$3\overline{)\$.11}$
4.	$4\overline{)\$.19}$	$6\overline{)\$.26}$	$9\overline{)\$.60}$	$6\overline{)\$.46}$	$7\overline{)\$.44}$
5.	$8\overline{)\$.28}$	$9\overline{)\$.39}$	$10\overline{)\$.33}$	$12\overline{)\$.20}$	$8\overline{)\$.66}$

Nearest tenths and hundredths

1. Martha bought a set of 5 tubes of paint for 82¢. To find the cost of each tube, she did this division: → Martha said, "The cost of each tube *to the nearest cent* is 16¢."

$$5\overline{)\$.820}\quad \$.164$$

Check her statement, using this table: →

16¢
16.1¢
16.2¢
16.3¢
16.4¢
16.5¢
16.6¢
16.7¢
16.8¢
16.9¢
17¢

2. Use the table to help you express to the nearest cent:

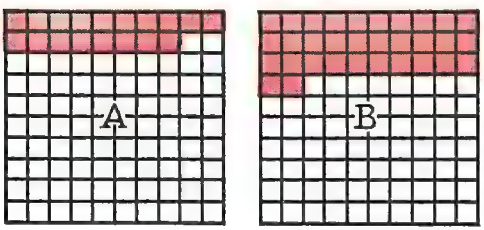
16.1¢   16.3¢ $.166 $.169

$.165 is an equal distance from 16¢ and _?_¢. It is customary to round off $.165 to $.17; $.185 to $.19; $.795 to $.80; and so on.

3. Express to the *nearest cent* or to the *nearest hundredth:*

$.173   .154 $.187 $.207   2.211   3.085

4. Jane says that .18 of Square A is colored. Do you agree?



5. Peter says that each row of small squares is .1 of Square A; so, expressed *to the nearest tenth,* .2 of Square A is colored, and _?_ tenths of Square A is not colored.

6. In Square B is more than .3 and less than .4 colored?

7. Expressed to the nearest tenth, what part of Square B is colored? not colored?

8. Express *to nearest tenth:*

.43   .66   .70   1.88
2.74   3.65   3.928   4.781

9. Express these numbers *to the nearest hundredth:*

.082   .177   .651
4.628   5.745   5.783

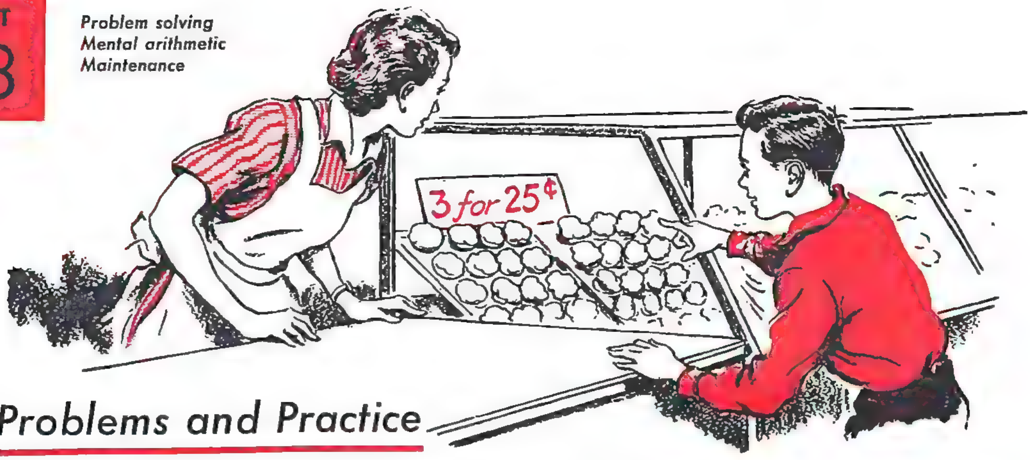
10. Make a rule for rounding off a 2-place decimal to a 1-place decimal; for rounding off a 3-place decimal to a 2-place decimal.

Divide. Carry each answer to two decimal places. Then express each answer to the nearest tenth.

	a	*b*	*c*
11.	$8\overline{)1.80}$	$6\overline{).53}$	$7\overline{)24.97}$
12.	$9\overline{).66}$	$5\overline{)4.79}$	$.06\overline{)3.07}$
13.	$7\overline{)6.1}$	$4\overline{)8.23}$	$.7\overline{)4.08}$

UNIT 28

Problem solving
Mental arithmetic
Maintenance



Problems and Practice

1. What is a quick way of finding the cost of a dozen of the cream puffs shown in the picture?

2. Twelve camp stools cost \$13.50. What is a quick way of finding the cost of 24 camp stools?

3. A car travels 23 miles in $\frac{1}{2}$ hr. What is a quick way to find the distance it travels in an hour?

4. If $\frac{3}{4}$ yd. of velvet costs \$6.00, what is a quick way of finding the cost of $\frac{1}{4}$ yd.? of $\frac{3}{8}$ yd.?

5. Ten notebooks cost \$4.80. What is a quick way of finding the cost of 5 notebooks?

6. If 10 ft. of pipe weigh 3.4 lb., what is a quick way to find the weight of 100 ft. of the pipe?

7. A non-stop train from Denver to Chicago made a record run of 1015.31 mi. in 13.1 hr.

What was the average speed per hour? Express your answer to the nearest tenth of a mile.

Find the answers and check:

	a	*b*	*c*	*d*
8.	\$50 − \$35.38	\$269.64 ÷ 36	\$463.27 ÷ 25	.4 × .18
9.	15.1 − 9.78	\$765.70 ÷ \$.95	80 × \$.69	2.5 × 3.7

Tell whether each statement is true or false. Do not use a pencil. Just think whether the answer is reasonable.

10. 1 ÷ .1 = 10

11. 1 ÷ .01 = 100

12. 4 × .5 = 20

13. 2 ÷ 1 = 20

14. 4.8 + .24 = 7.2

15. 6.8 − 2 = 4.8

16. 1000 × .001 = 1

17. 10 × .1 = 1

18. 100 × .01 = 1

19. .5 × .5 = .25

20. 5.5 − 5 = .5

21. .03 ÷ .01 = 3

Using arithmetic

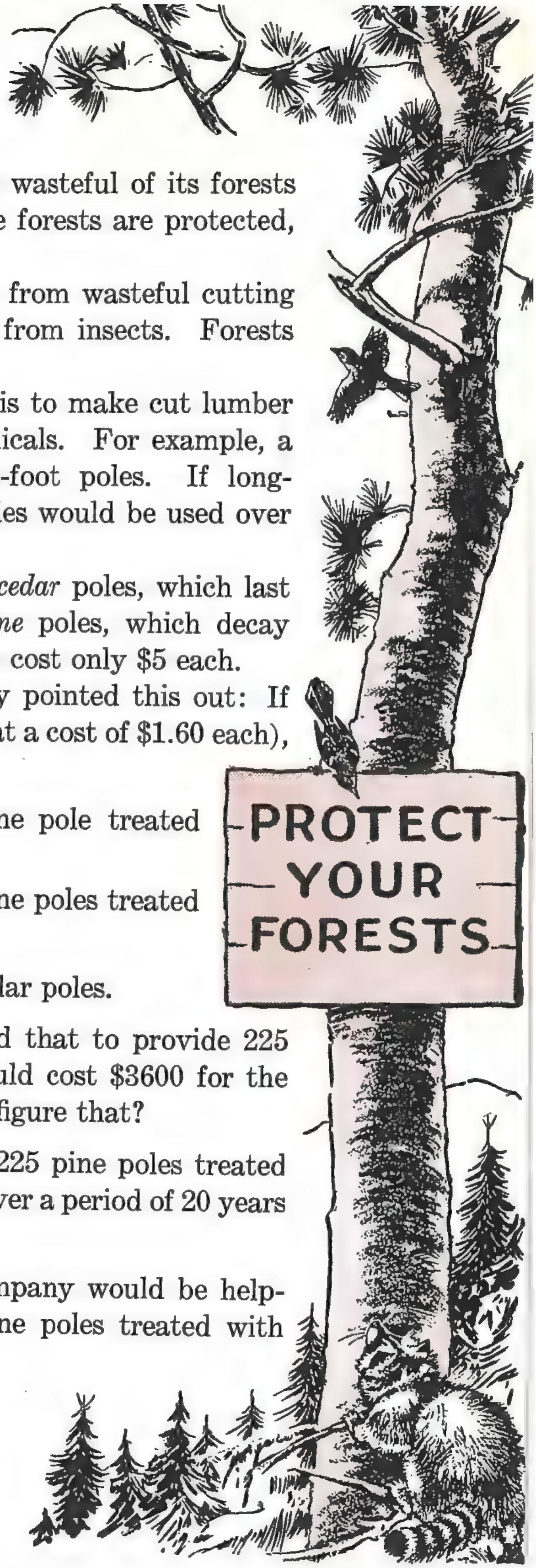
The United States has been more wasteful of its forests than any other country. Unless the forests are protected, they will soon be used up.

Forests need protection from fire, from wasteful cutting (such as leaving high stumps), and from insects. Forests need also to be replanted.

Another way of saving woodland is to make cut lumber last longer by treating it with chemicals. For example, a telephone company needed 225 40-foot poles. If long-lasting poles were selected, fewer poles would be used over a long period of years.

The company found that 40-foot *cedar* poles, which last 10 years, cost $8 each. 40-foot *pine* poles, which decay much more quickly than cedar poles, cost only $5 each.

Then an engineer of the company pointed this out: If pine poles are treated with creosote (at a cost of $1.60 each), they will last 20 years.



1. Find the cost of a 40-foot pine pole treated with creosote.

2. Find the cost of 225 40-foot pine poles treated with creosote.

3. Find the cost of 225 40-foot cedar poles.

4. The telephone company figured that to provide 225 cedar poles for a 20-year period would cost $3600 for the wood alone. How did the company figure that?

5. The company also figure that 225 pine poles treated with creosote would cost $2,115 less over a period of 20 years than cedar poles. Do you agree?

6. Explain how the telephone company would be helping to save our forests by using pine poles treated with creosote instead of cedar poles.

Be your own teacher

You have never been taught how to do these problems. But you can teach yourself. See how many different ways your class can discover to do each problem.

1. If you could count money at the rate of a dollar a second, how long would it take you to count a million dollars? a billion dollars? (Work 40 hours a week, 50 weeks a year.)

2. Tom charged 35 cents an hour for mowing lawns. During one week he worked as follows:

Monday	2 hr. 40 min.
Tuesday	1 hr. 50 min.
Wednesday	2 hr. 15 min.
Thursday	30 min.
Friday	1 hr. 20 min.
Saturday	4 hr. 35 min.

His average daily earning was _?_ cents.

3. Jane has 2 pieces of ribbon. One piece contains $2\frac{3}{4}$ yd.; the other $2\frac{2}{3}$ yd.

She cut _?_ inches off the longer piece to make the two pieces equal.

4. Would you be willing to work for 10 hours if you were paid 1 cent for the first hour, 2 cents for the second hour, 4 cents for the third hour, 8 cents for the fourth hour, and so on?

Your average hourly earnings would be _?_ cents an hour.

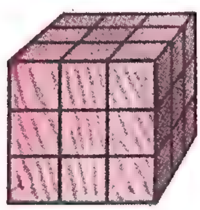
5. Tom can plow the potato field in 3 hr. Bill can plow it in 2 hr. If both work together, how long will it take them?

6. When wheat sells for $2 a bushel (60 lb.), how much would a bag containing 126 lb. sell for?

7. If $\frac{3}{4}$ of the sixth-grade pupils belong to Junior Red Cross and $\frac{2}{3}$ of the fifth-grade pupils belong, could you say that more sixth-grade pupils than fifth-grade pupils belong? Why not?

8. Tom set 30 tomato plants in his 16′ by 24′ rectangular garden. He said: "If my garden had been 32′ by 48′, I would have been able to set _?_ plants."

9. Bill had a block of wood, 3 inches on a side. He sawed it, as shown.



Then he had _?_ little blocks.

10. Bill's big block was painted red. How many little blocks were red on all 6 sides? on 3 sides? on 2?

To the Teacher: See Note 7, page 310.

No pencils, please!

1. Bob has 25¢ and his brother Dick has 15¢.

Make up an addition problem using the above facts; a subtraction problem using those facts; a division problem.

2. Moving the decimal point one place to the right _?_ (multiplies or divides) the number by 10. Give an illustration.

3. Moving the decimal point two places to the left _?_ (multiplies or divides) the number by _?_. Give an illustration.

4. A 10-lb. ham cost $5.90, or _?_ cents a pound.

5. When chicks are selling for $13.50 per hundred, the price per chick is _?_ cents.

6. If floor boards cost $92 per thousand feet, the price per foot is _?_ cents.

7. At 2.8 cents per foot, the cost of 1000 ft. of wire cable is _?_ dollars.

8. What is .1 of each of these numbers? 20 200 2 2000

9. Divide each of the numbers in Ex. 8 by 100.

10. $.025\overline{)10}$ means, "How many _?_ are there in 10?"

11. In changing $.025\overline{)10}$ to $25\overline{)10000}$, you are making the divisor a whole number by multiplying it by _?_.

You also are multiplying the dividend, 10, by _?_.

12. Does $10\overline{)2.34} = 23.4$, 234, or .234?

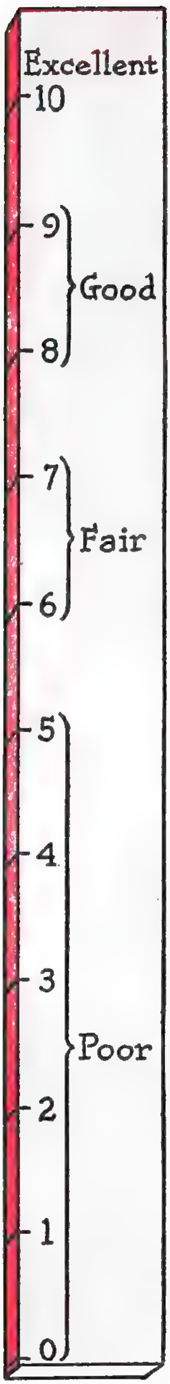
13. Does $100\overline{)7.5}$ equal 750, .75, or .075?

14.	27×10	$40.3 \div 100$
15.	$100\overline{)26.9}$	$.403 \times 100$
16.	$.46 \times 100$	$7.2 \div 100$
17.	$3.5 \div 100$	19×1000
18.	$70 \div 10$	$1000 \times .03$
19.	$28.3 \div 10$	9.5×1000
20.	$606 \div 100$	99×100
21.	$606 \div 1000$	$88 \div 10$
22.	$.006 \times 10$	$70 \div 1000$

23. Which of these has a value more than 1? $\frac{2}{3}$ $\frac{3}{4}$ $\frac{3}{2}$ $\frac{5}{6}$

24. Which of these has a value less than 1? $1 \div .1$ $\frac{100}{100}$ $3 \times .2$

Problem Test 5



Measure your growth in problem solving.

1. Alice wants to put shelf paper on 4 shelves each 27 in. long. Show that a 10-foot roll of paper will be long enough.

2. Jane bought this bolt of ribbon. She used $1\frac{3}{4}$ yd. and $2\frac{1}{2}$ yd.

How can she find out how much ribbon she has left without unwinding the ribbon and measuring? How much ribbon has she left?

3. Last week Kenneth gathered 390 eggs and sold them at 48¢ a dozen. How much money did he get?

4. Kenneth sells his eggs in boxes and can buy 100 boxes for $.50. At that rate, how much does one box cost?

5. At the rate of 2 bunches for 17¢, how much will 6 bunches of beets cost?

6. Ed Ford has a plot 24 feet square in his father's nursery. How many dwarf pines can he set out if he allows 4 sq. ft. for each tree? Draw a picture of the problem.

7. What is the cost (to the nearest cent) of one handkerchief if you get 6 for a dollar?

8. A road map gives two routes from Glendale to Milford. How much shorter is the route marked 36.6 mi. than the one marked 42.2 mi.?

9. How many $1\frac{1}{2}$-yard lengths can Dean cut from 12 yards of burlap?

10. How far will a motorcycle going at a rate of 38.5 mi. an hour travel in 2.5 hr.?

Write your score on your Problem Test record.

Thinking about division

1. What is $\frac{1}{10}$ of 100? of 10? of 1? of .1? of .01?

2. Finding $\frac{1}{10}$ of a number is the same as dividing the number by _?_.

3. How many tenths are there in $\frac{1}{10}$? in 1? in $1\frac{1}{10}$? in 11? in 110?

4. Divide each number by .1:

1 .1 1.1 11 110

5. Dividing a number by $\frac{1}{10}$, or .1, is finding how many times the number contains _?_.

6. $2\overline{).2}$ means $\frac{1}{2}$ of 2 tenths, or 2 tenths ÷ _?_.

$.2\overline{)2}$ means "How many times is ? contained in _?_?"

7. What is $\frac{1}{100}$ of each of these numbers?

1000 100 10 1 $\frac{1}{10}$ .1

8. Finding $\frac{1}{100}$ of a number is the same as dividing the number by _?_.

9. How many hundredths are there in $\frac{1}{100}$? in $\frac{1}{10}$? in 1? in $1\frac{1}{100}$? in $10\frac{1}{10}$? in 101?

10. Divide each of these numbers by .01:

1 .1 .01 1.01 10.1 101

11. Dividing a number by $\frac{1}{100}$, or .01, is finding how many times the number contains _?_.

12. Divide each of the numbers in Ex. 7 by .01.

13. Do these all mean the same?

$.01\overline{)10}$ $\frac{10}{.01}$ $\frac{1}{100}$ of 10

10 ÷ .01 $\frac{1}{10}$ of 100

Without using your pencil, tell which answer will be larger:

14. $4.9\overline{)20.6}$ or $4.9\overline{)26.0}$

15. $3.2\overline{)200}$ or $3.3\overline{)200}$

16. $7.01\overline{)50}$ or $7.10\overline{)50}$

17. $2.4\overline{)204}$ or $2.4\overline{)200}$

18. 2.7×3.5 or $.89 \times 3.5$

19. When you change $.12\overline{)30}$ to $12\overline{)3000}$, are you:

- multiplying both divisor and dividend by 100?
- multiplying both numerator and denominator by 100?
- moving the decimal point two places to the right in both divisor and dividend?
- changing the quotient?
- making the "pointing off" of the quotient easier?

Self-Help Test 7

1. A puppy marked \$12.75 was put on sale at $\frac{1}{5}$ off the marked price. What was the new price of the puppy? (178)

2. Divide 680 by 32. Express the remainder as a decimal. (207)

3. Find the cost of $5\frac{3}{4}$ tons of sand at \$6.50 a ton. (96)

4. Divide 4.8 by 7. Carry the answer to two decimal places. (209)

5. What is the cost (to the nearest cent) of one link for a bicycle chain if you can buy 4 of the links for 59¢? (209)

6. Peter did 15 examples in $7\frac{1}{2}$ minutes. At that rate, how many examples did he do in 1 minute on the average? (133)

7. How long will it take a troop of Girl Scouts to hike 16.1 mi. at the rate of 3.5 mi. an hour? (203)

8. If $\frac{1}{4}$ in. on a map represents 40 mi., how long a distance is represented by a line $\frac{1}{2}$ in. long? $\frac{3}{4}$ in.? $1\frac{1}{4}$ in.? (150)

9. Without working these divisions, tell in which one the quotient will be largest.

$.29\overline{)116}$ $.29\overline{)11.6}$ $.29\overline{)1.16}$ (80)

10. Estimate to see if the quotient in the division $46\overline{)2438}$ is 60-some or 50-some or more than 600. (50)

11. Estimate to see if the quotient in the division $8\overline{)2832}$ has 2 digits or 3 digits or 4 digits. (36)

Self-Help Test 8

1. $\frac{4}{5} \times 2\frac{1}{3}$ (110)
2. $2\frac{2}{5} \div \frac{1}{2}$ (140)
3. $10 \times \$6.24$ (191)
4. $2.4 \div 10$ (205)
5. $8 \times .16$ (186)
6. $8\overline{)40.16}$ (198)
7. $2\frac{2}{3} \times \frac{7}{8}$ (110)
8. $\frac{5}{6} \div 1\frac{1}{3}$ (142)
9. $61.2 \div 36$ (198)
10. $12 \div 2\frac{1}{3}$ (133)
11. $.2 \times .19$ (188)
12. $.09\overline{)6.21}$ (203)
13. $4\frac{1}{4} \times 1\frac{1}{2}$ (111)
14. $5\frac{1}{4} \div 2\frac{1}{2}$ (143)
15. $84 \div .07$ (203)
16. $12.2 - 5.7$ (174)
17. 2.7×4.8 (186)
18. $24\overline{).96}$ (204)

Self-Help Test 9

1. If $\frac{1}{8}+\frac{1}{8}+\frac{1}{8}+\frac{1}{8}=\frac{4}{8}=\frac{1}{2}$, then which of the following are true?

$\frac{1}{8}\div\frac{1}{2}=\frac{1}{4}$ $\qquad$ $\frac{1}{2}\div\frac{1}{8}=4$

$4\div\frac{1}{2}=8$ **(128)**

2. If $76\times 94=7144$, then which of the following are true?

$74\times 96=7144$
$7144\div 96=74$
$7144\div 76=94$ **(80)**

3. If a pony gains 118.8 lb. in 3 months, what is the average gain a month? **(54)**

4. Write as common fractions and reduce to lowest terms:

.8 $\quad$ .25 $\quad$ 4.5 $\quad$ 4.08 **(157, 161)**

5. $.09+2.56+1.16$ **(173)**

6. At 50¢ a square yard, how much will it cost to clean a rug 3 yd. by 4 yd.? **(122)**

7. How far will a train traveling at the rate of 47.5 mi. an hour go in 2.4 hr.? **(99)**

8. Write in figures: 8 billion, 125 thousand. **(8–9)**

9. Write as decimals:

$\frac{9}{1000}$ $\quad$ $1\frac{1}{10}$ $\quad$ $3\frac{23}{100}$ **(157, 160, 164)**

10. At 4 for a nickel, how many pencils can you buy for 25¢? for 20¢? 30¢? 15¢? **(101)**

11. What part of a foot is 3 in.? 4 in.? 6? 2? 8? 10? **(105)**

12. From 19.1 take .8; take 2.5; take 5.7. **(174)**

Self-Help Test 10

1. $.3\times 2.7$ **(186)**

2. $\frac{5}{12}+\frac{7}{8}$ **(67)**

3. $16-5\frac{7}{12}$ **(70)**

4. $\frac{3}{4}\times 16$ **(91)**

5. $\frac{5}{6}\times\frac{3}{4}$ **(90)**

6. $\frac{5}{12}\div\frac{2}{3}$ **(136)**

7. $24\overline{)19.2}$ **(198)**

8. $\frac{4}{5}+\frac{1}{2}$ **(67)**

9. $12\frac{1}{4}-5\frac{2}{3}$ **(72)**

10. $\frac{7}{8}$ of 24 **(91)**

11. $\frac{3}{4}$ of $\frac{4}{5}$ **(90)**

12. $\frac{2}{3}\div 8$ **(137)**

13. $.08\overline{).72}$ **(203)**

14. $3\frac{1}{3}=\frac{?}{3}$ **(61)**

15. $\$4.50\div 2\frac{1}{4}$ **(135)**

16. $\frac{2}{3}\times 11$ **(91)**

17. $2\frac{2}{3}\times 21$ **(95)**

18. $4\frac{1}{2}\div\frac{3}{4}$ **(140)**

Measuring your growth in arithmetic

Copy the examples correctly. Work carefully. Check your work. Be sure your answers are reasonable.

1. Multiply 82 by 3.6.

2. Find $.3 \times .09$.

3. Multiply $4.75 by 10.

4. Divide 7.83 by .18.

5. Which of these is a reasonable answer for 8×2.03?

1624 16.24 1.624 162.4

Which of these is a reasonable answer for $8 \div 2.03$?

.039 394 3.94 4.93

6. What is the average rate of a motor bike that travels 22.5 mi. in 1.5 hr.?

7. If 100 plants cost $4.50, how much is that per plant?

8. The cost of running the Millersville School Bus is 19.2¢ a mile. Each day the bus travels a total of 46.5 miles.

How much does it cost to run the bus for a 5-day school week?

Just for fun

Here are some "alphabet" divisions. See if you can figure out what number each letter stands for. The value of a letter or two is given in the box below each division to help you start.

1.
$$\begin{array}{r} \mathrm{A\ rB} \\ \mathrm{A}\overline{)\mathrm{BC}} \\ \underline{\mathrm{BA}} \\ \mathrm{B} \end{array}$$

A	B	C
6	?	?

2.
$$\begin{array}{r} \mathrm{A\ rC} \\ \mathrm{A}\overline{)\mathrm{BA}} \\ \underline{\mathrm{BC}} \\ \mathrm{C} \end{array}$$

A	B	C
8	?	?

3.
$$\begin{array}{r} \mathrm{BE} \\ \mathrm{AB}\overline{)\mathrm{CDEF}} \\ \underline{\mathrm{CGB}} \\ \mathrm{JCF} \\ \underline{\mathrm{JCF}} \end{array}$$

A	B	C	D	E	F	G	J
3	5	?	?	?	?	?	?

4. Now see if you can make up some alphabet divisions for your friends to solve.

The Pennsylvania Turnpike

Here are some facts about the Pennsylvania Turnpike, a superhighway that runs across the state of Pennsylvania:

Length: 327 miles
Number of tunnels through mountains: 7
Combined length of all tunnels: 35,000 feet
Longest tunnel: 6,782 feet
Shortest tunnel: 3,532 feet
Full-length fare for passenger cars, motorcycles, buses: $3.25
Maximum speed limit: 70 miles an hour
Cost: about 240 million dollars

Use the above facts to help you answer Exs. 1–7.

1. Would you estimate the charge per mile for driving the length of the Turnpike to be about 1¢, 10¢, or $1.00?

2. Is the average length of the 7 tunnels on the Turnpike a little more than a mile or a little less than a mile?

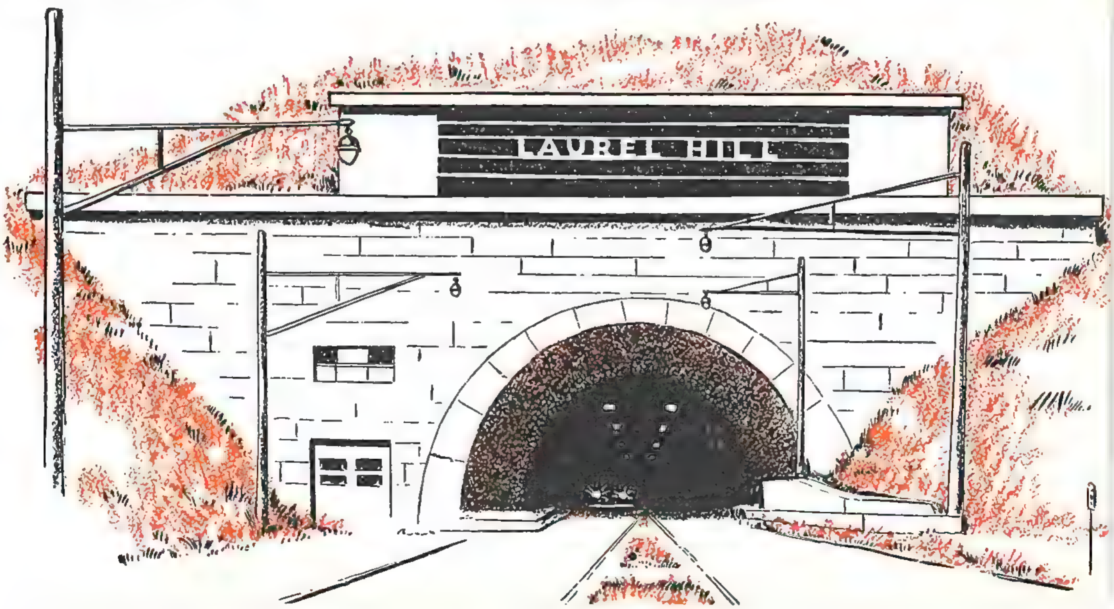
3. Is the length of the longest tunnel about $1\frac{1}{4}$ miles, $1\frac{1}{2}$ miles, or 2 miles?

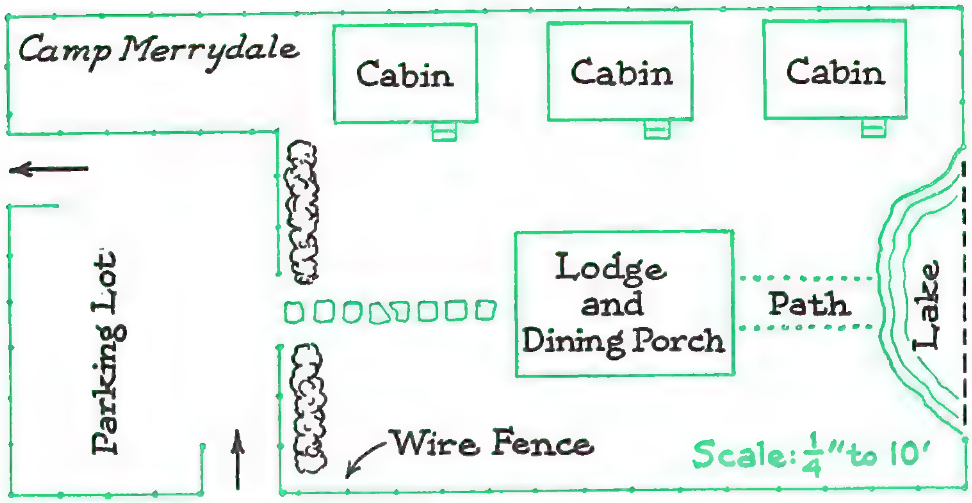
4. Is the length of the shortest tunnel about $\frac{1}{2}$ mile, $\frac{2}{3}$ mile, or $\frac{9}{10}$ mile?

5. About how long would it take to drive the length of the Turnpike if you drove as fast as the law allows?

6. Is the speed limit on the Turnpike more or less than a mile a minute?

7. Was the cost of building the Turnpike more or less than a million dollars a mile?





Scale drawings

A scale drawing of Camp Merrydale is shown above.

The drawing of the buildings and grounds is the same shape as the real buildings and grounds.

One-fourth inch on the drawing represents 10 ft. at the camp.

1. Since $\frac{1}{4}$ in. on the drawing represents 10 ft. at the camp, how long a distance does $\frac{1}{2}$ in. represent? $\frac{3}{4}$ in.? $\frac{1}{8}$ in.? $\frac{3}{8}$ in.? $\frac{5}{8}$ in.?

2. Since $\frac{1}{4}$ in. on the drawing stands for 10 ft., then 1 in. on the drawing stands for _?_ ft.

How much does $1\frac{1}{4}$ in. on the drawing stand for? $1\frac{1}{8}$ in.? $1\frac{1}{2}$in.? $1\frac{3}{8}$ in.? $1\frac{3}{4}$ in.? 2 in.?

3. Below is a table showing some of the distances you worked out in Exs. 1 and 2. Tell the missing numbers in it.

4. Measure the lodge. Use the table below to find how long the lodge is; how wide.

5. How long is each cabin? How wide?

6. How long is the parking area? How wide?

7. How wide is the road leading into the parking lot?

8. What are the dimensions of the camp grounds?

TABLE SHOWING DISTANCES ON A SCALE OF $\frac{1}{4}''$ TO $10'$

INCHES ON DRAWING	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	?	$1\frac{1}{8}$	$1\frac{1}{4}$	?	$1\frac{1}{2}$
DISTANCE IN FEET	5	10	15	?	25	30	?	40	?	?	55	60

Practice with scale drawings

On maps, you often see the scale of the map shown in this form:

1. On the edge of a strip of paper mark the length of the drawing of the lodge on page 220. Lay the paper along the scale above.

You find the lodge is ? ft. long.

What length did you find the lodge to be in Ex. 4 on page 220?

2. Mr. Spear has just bought a city lot with a 90-foot front and a 160-foot depth.

On this lot he is planning to make the following improvements:

- Lay a 5′ sidewalk along the front.
- Build a house 45′ × 30′.
- Build a garage 15′ × 20′.
- Lay out a vegetable garden 35′ × 65′.
- Make a play area 40′ × 75′.

Draw Mr. Spear's lot to scale. Use a scale of $\frac{1}{2}''$ to 10′.

3. Cut out rectangles (drawn to the same scale as Mr. Spear's lot) for the buildings and areas.

Move these pieces about on the lot until you get a good layout for Mr. Spear. Then you can draw them in place. Label each.

4. Make a table for a scale of $\frac{1}{2}''$ to 1 mile. Have the distances go by fourths of a mile up to 4 miles.

Use the table you made in Ex. 4 to work Exs. 5–7.

5. Draw a line representing $2\frac{1}{2}$ miles.

6. What distance will a $3\frac{1}{2}$-inch line represent? a $3\frac{1}{4}$-inch line?

7. Draw a line representing $\frac{3}{4}$ of a mile.

8. What does a line $1\frac{1}{2}$ in. long represent when the scale is 60 mi. to an inch? 70 mi. to an inch?

9. Letting .5 in. represent a mile, how long a line would you draw to represent 6 mi.? 10 mi.?

10. Sometimes farm land is measured in ***rods***. Measure off a rod on your school grounds.

$16\frac{1}{2}$ ft.	**=**	**1 rod (rd.)**
$5\frac{1}{2}$ yd.	**=**	**1 rd.**
320 rd.	**=**	**1 mi.**

11. Letting $\frac{1}{8}$ in. represent 1 rod, how long a line would you draw to represent 10 rd.? $\frac{1}{4}$ mile?

FIGURE 1

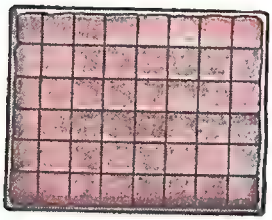


FIGURE 2

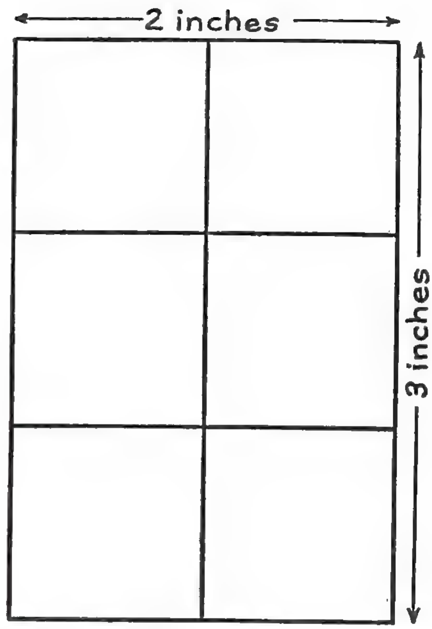


FIGURE 3

Finding area

Study Figures 1, 2, and 3 above.

1. Tell a quick way of finding how many stamps there are in Figure 1.

2. Tell a quick way of finding the number of pieces of fudge in Figure 2.

3. In Figure 3 there are 2 square inches in the top row of squares because the rectangle is _?_ in. wide.

4. There are 3 rows of square inches in Figure 3 because the rectangle is _?_ in. long.

5. How can you find the number of square inches in Figure 3?

The number of square inches in the rectangle is called the _?_ of the rectangle.

6. The length and the width of a rectangle are its ***dimensions.***

What are the dimensions of the rectangle shown in Figure 3?

7. Explain the rule below for finding the area of a rectangle. Illustrate it.

8. What is the area of a rectangle which has dimensions of 8′ and 5′?

The area of a rectangle is found by multiplying the number of units in the length by the number of units in the width.

Practice in finding areas

1. Ted's father asked him to order enough bone meal to fertilize the front lawn. He said to allow 5 lb. of bone meal for each 100 sq. ft. of lawn.

What did Ted have to know about the lawn before he could decide how much bone meal to order?

2. Ted "stepped off" the front lawn. It was 24 of his steps long and 16 of his steps wide. His step, or *pace*, is about $2\frac{1}{2}$ ft.

How many feet long was the lawn? How many feet wide?

3. What was the area of the lawn?

4. How much bone meal did Ted need for his lawn?

5. Ted found the price of bone meal to be:

5 lb., 75¢	50 lb., $4.50
20 lb., $2.25	100 lb., $8.00

Use your answer to Ex. 4 and the price list of the bone meal to find how much Ted spent for bone meal.

6. A corral is 250 ft. long and 150 ft. wide. How many square feet are there in the corral?

7. How many square feet of flooring are needed to cover a barn floor 40 ft. by 24 ft.?

8. A garden is 30 ft. long and 20 ft. wide. How many square feet of ground does it cover?

9. A rectangle contains 48 sq. ft. How wide is it if it is 6 ft. long? ($6 \times N = 48$; $N = \underline{\ ?\ }$)

10. A rectangle contains 48 sq. ft. How wide is it if it is 8 ft. long? 12 ft. long? 16 ft. long?

11. If the area of a rectangle is 96 sq. ft., what is its length if its width is 6 ft.? 8 ft.? 12 ft.?

12. Make up a rule for finding the width of a rectangle if you know its area and length.

13. Make up a rule for finding the length of a rectangle if you know its area and width.

Find the areas of rectangles with these dimensions:

	a	*b*	*c*
14.	4 in. wide, $6\frac{1}{2}$ in. long	$33\frac{1}{3}$ yd. by 15 yd.	9.5 rd. by 7.3 rd.
15.	6 ft. wide, $8\frac{1}{3}$ ft. long	28 yd. by $20\frac{1}{2}$ yd.	3 mi. by 4 mi.
16.	18 ft. wide, 22.5 ft. long	15 rd. by $8\frac{1}{3}$ rd.	9.5 ft. by 8.7 ft.

What is an acre?

1. Tell what each of these measures of area means.

How many of them could you draw on the blackboard?

square inch	square yard
square foot	square rod
square mile	

2. Another unit of measure, the *acre* is often used in measuring the area of land.

Do you know any piece of land that contains an acre?

3. An acre covers an area of 43,560 sq. ft.

How can you prove that a square 210 feet on each side contains very nearly an acre?

4. If your step is $2\frac{1}{2}$ ft. long, how many steps will you have to take to measure off 210 feet?

If possible, measure off an acre on your playground; that is, pace off a square that is 210 ft. on each side.

5. Using a scale of $\frac{1}{4}$ in. to 30 ft., make a scale drawing of the acre you paced off in Ex. 4.

6. Make a list of any vacant lots, fields, parking areas, lawns, or playgrounds in your neighborhood that you think contain about an acre of land.

7. An acre of land does not need to be in the shape of a square.

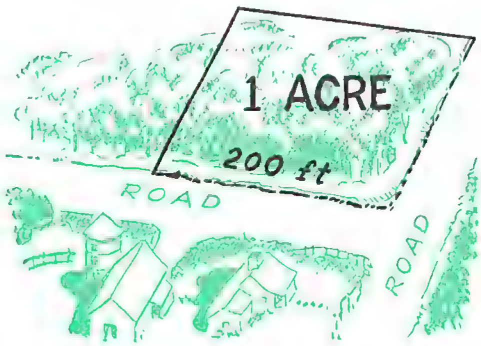
A rectangle 229 ft. long and 190 ft. wide contains almost an acre (nearly 43,560 sq. ft.).

Prove it.

8. A piece of land containing an acre (43,560 sq. ft.) is 160 ft. wide. Find the length of the piece of land.

($N \times 160 = 43{,}560$; $N = \underline{\ ?\ }$)

9. Tom's father wants to sell an acre of woodland. The land runs 200 ft. along the road.



How far back into the woods will the acre of land run?

10. Compare an acre (43,560 sq. ft.) with a football field 360 ft. long and 160 ft. wide.

Which is larger? How much larger?

11. There are 640 acres in 1 sq. mi. The Webers' ranch covers 2 sq. mi. How many acres are there in the ranch?

Changing measures of areas

1. Draw on the blackboard a square foot. Draw lines to divide it into square inches.

Your drawing shows there are _?_ square inches in 1 square foot.

2. Draw a square yard. Divide it into square feet.

Your drawing shows there are _?_ sq. ft. in 1 sq. yd.

3. Use your answers to Exs. 1 and 2 to find how many square inches there are in a square yard.

4. Ken and his father are putting linoleum on their rumpus room floor, which is 18′ by 12′.

The floor area is _?_ sq. ft.

5. One gallon of linoleum paste is needed to put down 12 sq. yd. of linoleum.

How many square yards of linoleum does Ken (Ex. 4) need? (216 sq. ft. = _?_ sq. yd.)

How many gallons of paste should he buy?

6. At 10¢ a square foot, how much would it cost to have a 24″ by 36″ rug cleaned?

7. The floor of a bunkhouse is 24′ by 18′. It contains _?_ square feet, or _?_ square yard.

Find in square feet the areas of the following rectangles:

8. 9 yd. $\times$ 5 yd. **9.** 36″ $\times$ 24″

Find these areas in square yards:

10. 18′ $\times$ 23′ **11.** 24′ $\times$ 27′

Are these statements true or false?

12. To change square inches to square feet, divide by 144.

13. To change square feet to square inches, multiply by 12.

14. To change square feet to square yards, divide by 3.

15. To change square yards to square feet, multiply by 9.

16. The area of a piece of ground might be 17 rods.

17. The area of a rectangular piece of land might be an acre.

18. The area of a board 8 ft. long and 6 in. wide is $8 \times \frac{1}{2}$, or 4 sq. ft.

LEARN THESE

144 sq. in. = 1 sq. ft.
9 sq. ft. = 1 sq. yd.
160 sq. rd. = 1 acre
640 acres = 1 sq. mi.

Measurement

1. Miss Carter asked her class to find the area of a shelf 3 ft. long and 8 in. wide.

Draw an exact diagram of the shelf on the blackboard.

2. By looking at your drawing of the shelf, estimate whether its area is about 2 sq. ft., 24 sq. ft., or 24 sq. in.

3. Below are two solutions of Ex. 1. Explain each, and show that the two answers are equal.

FIRST SOLUTION

Width = 8 in. = $\frac{8}{12}$ = $\frac{2}{3}$ ft.

Length = 3 ft.

$\frac{2}{3} \times \frac{\cancel{3}^{1}}{1} = 2$ Area = 2 sq. ft.

SECOND SOLUTION

Width = 8 in.

Length = 3 ft. = 36 in.

$$\begin{array}{r} 36 \\ \times 8 \\ \hline 288 \end{array}$$

Area = 288 sq. in.

> When you find the area of a rectangle, you must have its length and width in the *same unit of measure;* that is, the length and width must both be in inches or both in feet, or both in yards, etc.

Find the areas of these rectangles:

4. $9'' \times 2'$

5. 2 ft. $\times$ 3 yd.

6. To find the number of square feet in a rectangle 2 ft. 3 in. wide and 3 ft. 6 in. long, Nancy did this multiplication: $2\frac{1}{4}' \times 3\frac{1}{2}'$. Was that right? Find the area.

7. Which has the larger area, a raft $3' \times 5'$ or a raft $4'$ square?

8. How many acres are there in a field 16 rods by 40 rods?

9. Years ago our government sold land in the Northwest for $1.25 an acre. Pioneers of the Everett family bought farm lands 1.5 mi. long and .5 mi. wide.

Can you tell how much they paid for it at that price?

10. Leo raised 42 bu. of wheat on a field 20 rd. long and 19.2 rd. wide. What was the area of his field in square rods? in acres?

Leo says the average yield per acre was $17\frac{1}{2}$ bu. Was it?

11. Jean has a package of assorted flower seeds containing enough seeds for a garden $8' \times 10'$.

Jean's garden is $5.5' \times 14'$. Has she enough seeds?

12. John says that an asparagus patch 20 rods long and 8 rods wide covers exactly an acre of ground. Do you agree with John?

Fraction and decimal review

Copy, work, and check. Watch the signs.

	a	b	c	d
1.	$\frac{7}{10} + \frac{7}{10}$	$\frac{1}{4} + \frac{1}{5}$	$3\frac{1}{4} + 1\frac{3}{4}$	$2\frac{1}{2} + 7\frac{4}{5}$
2.	$\frac{3}{4} + \frac{5}{12}$	$\frac{7}{16} + \frac{9}{16}$	$5\frac{5}{6} + 1\frac{11}{12}$	$6\frac{1}{3} + \frac{3}{4}$
3.	$\frac{10}{16} - \frac{5}{16}$	$\frac{2}{5} - \frac{1}{4}$	$8\frac{1}{6} - 2\frac{2}{3}$	$4\frac{2}{3} - 2$
4.	$\frac{2}{3} - \frac{5}{12}$	$5\frac{9}{10} - 1\frac{1}{2}$	$10 - \frac{5}{8}$	$2\frac{1}{2} - \frac{11}{16}$
5.	$3\frac{1}{4} \times 12$	$4\frac{1}{2} \times \frac{9}{10}$	$6 \times 2\frac{1}{4}$	$1\frac{1}{5} \times 1\frac{1}{4}$
6.	$8 \times \frac{3}{4}$	$\frac{3}{5} \times \frac{1}{2}$	$2\frac{2}{3} \times \frac{4}{5}$	$\frac{9}{10} \times 5\frac{1}{3}$
7.	$8 \times 10\frac{3}{4}$	$5\frac{1}{4} \times \$.18$	$4 \times 12\frac{2}{5}$	$6\frac{2}{5} \times \$4.20$
8.	$\frac{3}{4} \div \frac{2}{3}$	$\frac{5}{6} \div 1\frac{1}{4}$	$\frac{5}{6} \div 2$	$15 \div 3\frac{1}{3}$
9.	$4\frac{1}{2} \div 4$	$6 \div \frac{7}{8}$	$18 \div 1\frac{1}{3}$	$\$2.50 \div 3\frac{3}{4}$
10.	$6\frac{2}{3} \div \frac{4}{5}$	$2\frac{1}{4} \div 1\frac{1}{4}$	$\$2.00 \div 2\frac{1}{2}$	$\$1.75 \div 1\frac{1}{3}$

Add and check:

	a	b	c	d
11.	36.71 .72 8.64 3.75	96.0 8.7 63.4 9.7	.08 9.75 6.34 8.90	7.60 4.35 8.70 9.06

Subtract and check:

	a	b	c	d
12.	$42.23 - 16.1$	$32.44 - 12.9$	$24 - 2.78$	$76.4 - 9.8$

Multiply and check:

	a	b	c	d
13.	$.9 \times .22$	$.26 \times 3.5$	10×4.56	100×3.2

Divide and check:

	a	b	c	d
14.	$.8\overline{)4.056}$	$26\overline{)15.08}$	$.29\overline{)211.7}$	$4.76 \div 10$
15.	$.21\overline{)153.3}$	$4.6\overline{)15.64}$	$.125\overline{)625}$	$83.2 \div 100$

Thinking about area

1. Joe needed to buy two rectangular pieces of aluminum screen. One was to be 6 in. wide and 24 in. long; the other 4 in. wide and 36 in. long.

Joe decided that the two pieces were equal in area. How could he tell that?

2. Joe (Ex. 1) thought, "Each of the pieces contains a square foot, but neither piece is a foot square." Show that he was right.

3. The area of a rectangle 2 inches wide and 72 inches long is _?_ square inches, or _?_ square foot.

4. The area of a rectangle 1 inch wide and 144 inches long is _?_ square inches, or _?_ square foot.

5. Joe asked whether two rectangles that have equal areas also have equal perimeters. What do you think? (Draw two rectangles of equal area but different shapes. Compare their perimeters.)

6. Are rectangles having these dimensions equal in area?

12 in. × 12 in.	6 in. × 24 in.
3 in. × 48 in.	2 in. × 72 in.
1 in. × 144 in.	$\frac{1}{2}$ in. × 288 in.

7. Find the perimeters of the rectangles in Ex. 6. Which has the smallest perimeter? (Remember that a square is a rectangle with all sides equal.)

How do Exs. 6 and 7 help answer Joe's question in Ex. 5?

8. Joe wanted to enclose a rectangular space for his 18 baby chicks. Each chick was to have 8 square feet of area.

Joe said he wanted to use as little fence (perimeter) as possible. What dimensions should he use? (Exs. 6 and 7 may give you a hint on how to find this answer.)

9. Jane has a square garden 48 ft. on a side. Its area is _?_ square feet.

10. Mary's garden is a foot longer and a foot wider than Jane's (Ex. 9). Its area is _?_ square feet larger than Jane's.

11. Give the missing numbers:

Side of square (feet)	1	2	3	4	5	?	7	8
Area of square (square feet)	?	4	9	?	25	36	?	?

12. In Ex. 11, how does the area increase if the side of the square increases from 3 to 4? if the side increases from 4 to 5?

13. If you increase the length of each side of a square by 1 foot, do you increase its area by 1 square foot? (See Ex. 10.)

14. If you double the side of a square, the area of the square becomes how many times as great? (See Ex. 11.) Draw a diagram to prove your answer.

15. Tom paid 25 cents for a square piece of sheet copper, 8 inches on a side.

For a square 16 inches on a side, he should pay _?_ cents. Draw a diagram.

16. Use the advertisement below to find the cost of straw or hemp rugs of the following sizes:

$9' \times 12'$ $\quad$ $6' \times 8'$ $\quad$ $12' \times 15'$

17. On the blackboard draw a rectangle whose dimensions are 18 in. $\times$ 24 in. Find its area.

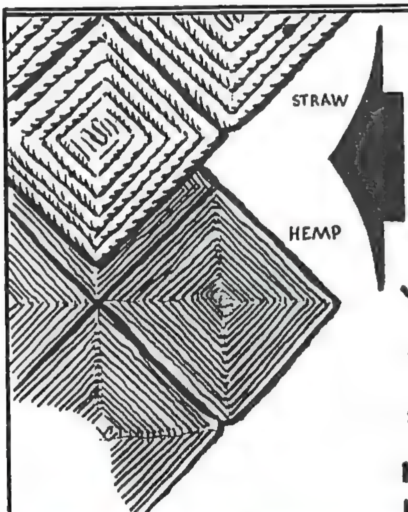
Now draw a rectangle whose dimensions are 1 inch greater than those of the first rectangle. Find its area.

The area of the second rectangle is _?_ square inches greater than the area of the first rectangle.

18. The floor plan of a room was drawn to the scale of 1 in. to 8 ft. On the drawing the room was 2 inches wide and 3 inches long.

The area of the room was _?_ square feet.

19. How many square yards of carpet would be needed to cover the floor of the room in Ex. 18?



hemp or straw braid squares
for *beautiful rugs!*

You buy the squares. We put them together for you in a rug the size you want at no extra cost.

12-INCH STRAW BRAID SQUARES each 42¢
12-INCH HEMP SQUARES; NATURAL each 60¢

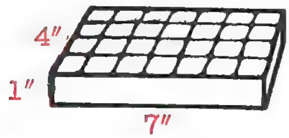
Petersham's rugs, fourth floor
come in, write or phone. Andover 8-7000

UNIT 30

Finding the volume of rectangular solids
Review of measurement facts

Finding volume

1. The box below contains _?_ marshmallows.



2. Each marshmallow is a *cube,* 1 in. long, 1 in. wide, and 1 inch thick. Each marshmallow is therefore a *cubic inch.* Cubic inch is written *cu. in.*

How can you find how many cubic inches there are in the box without counting every marshmallow?

3. The box is 7 in. long, 4 in. wide, and 1 in. deep; so there are 7×4 cu. in., or _?_ cu. in.

The *volume* of the candy box (the number of cubic inches held by the box) is 28 cubic inches.

4. If you put another box of marshmallows on top of the one above, would there be twice as many marshmallows?

The volume would then be $2 \times 7 \times 4$ cu. in., or _?_ cu. in.

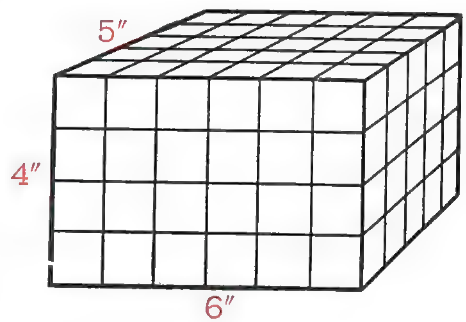
5. In 3 boxes there would be 3 layers with 28 cu. in. in each layer.

The volume of 3 layers is $3 \times 7 \times 4$ cu. in., or _?_ cu. in.

6. In 4 layers of marshmallows there would be _?_ $\times 7 \times 4$ cu. in., or _?_ cu. in.

7. Ted has a plastic box 6 in. long, 5 in. wide, and 4 in. high.

He wonders how many 1-inch plastic cubes (a cube 1 in. long, 1 in. wide, and 1 in. high) he can pack in the box.



- Show that in each layer he can put 6×5 cu. in., or _?_ cu. in.
- Show that the box will hold 4 layers of cubes.
- Show that the box will hold $4 \times 6 \times 5$ cu. in., or _?_ cu. in.
- The volume of Thomas' plastic box is _?_ cu. in.

8. Make up a rule for finding the volume of a box-shaped object when you know its three dimensions (length, width, height).

To find the volume of a box-shaped object, multiply its length by its width by its height.

Finding volume

How many cubic inches are there in boxes with these dimensions:

	a	b
1.	$3'' \times 8'' \times 2''$	$3\frac{3}{4}'' \times 4'' \times 3''$
2.	$4'' \times 8'' \times 3''$	$5\frac{1}{2}'' \times 6'' \times 3''$
3.	$6'' \times 2'' \times 8''$	$2\frac{1}{8}'' \times 3\frac{1}{2}'' \times 12''$
4.	$2\frac{1}{4}'' \times 3\frac{1}{2}'' \times 12''$	$2\frac{1}{3}'' \times 2\frac{1}{2}'' \times 8''$

A ***cubic inch*** (cu. in.) is a unit of measure 1 inch long, 1 inch wide, and 1 inch deep.

A ***cubic foot*** (cu. ft.) is a unit of measure 1 foot long, 1 foot wide, and 1 foot high.

A ***cubic yard*** (cu. yd.) is a unit of measure 1 yard long, 1 yard wide, and 1 yard high.

Volume may be measured in cubic inches, cubic feet, or cubic yards.

5. Show with your hands the dimensions of a box the size of a cu. in.; a cu. ft.; a cu. yd.

Find the volumes:

	a	b
6.	$3'' \times 4'' \times 5''$	$4' \times 5' \times 7'$
7.	$3' \times 4' \times 5'$	$2\frac{1}{4}' \times 2\frac{1}{2}' \times 4'$
8.	$6' \times 7' \times 3'$	$5' \times 2\frac{1}{2}' \times 3\frac{1}{2}'$

9. How many cubic inches are there in a box $12'' \times 12'' \times 12''$?

10. Ted says the box in Ex. 9 contains 1 cu. ft. Is he right?

11. Show that Exs. 9 and 10 prove that:

1728 cu. in. = 1 cu. ft.

12. How many cubic feet are there in a box 3 ft. by 3 ft. by 3 ft.?

13. Show that the box in Ex. 12 contains a cubic yard.

14. Show that Exs. 12 and 13 prove that:

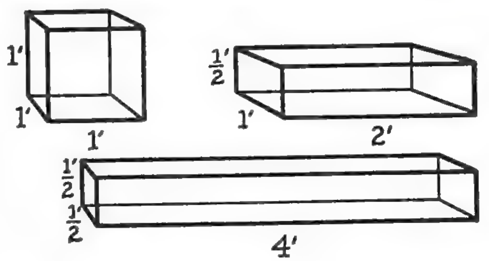
27 cu. ft. = 1 cu. yd.

15. How many cubic inches are there in 2 cu. ft.? $2\frac{1}{2}$ cu. ft.?

16. How many cubic feet are there in 2 cu. yd.? $3\frac{1}{2}$ cu. yd.?

17. How many cubic yards are there in 54 cu. ft.? in 108 cu. ft.?

18. Show that the volume of each of these boxes is 1 cu. ft.



19. Does a box 1 cu. ft. in volume have to be a cube? Must it be 1 ft. × 1 ft. × 1 ft.?

Measurement facts

1. A unit of measure that is accurately described or defined, and understood and used by everyone, is called a *standard unit.*

Our standard unit of length is the distance between two marks on a bar of platinum kept in the United States Bureau of Standards at Washington. It is called a *yard.*

All our other standard units of length are based upon the yard. Thus, the foot is $\frac{1}{3}$ of a yard. The inch is _?_ of a yard, and the mile is _?_ yards.

2. On page 224 you were asked to measure off an acre of land by pacing.

Do you think your step or pace is a standard unit of measure?

If you were buying a piece of land, would you rather have it measured by pacing or by a standard measuring instrument? Why?

3. Perhaps your class can appoint a committee to report on what the United States Bureau of Standards does and why its work is important.

4. Notice the table of measures at the bottom of the page. Can you name two more units for measuring length? two more units for measuring area?

5. Is it necessary to use units of length when you wish to find area?

6. Could you find the number of cubic feet a box contains without using units of length?

7. A goldfish pool is 4 ft. by 3 ft. 3 in. by 18 in. Nancy says its volume is $4 \times 3\frac{1}{4} \times 1\frac{1}{2}$ cu. ft., or _?_ cu. ft.

8. John says the volume of the pool (Ex. 7) is $48 \times 39 \times 18$ cu. in., or _?_ cu. in.

9. Show that the answers to Exs. 7 and 8 are equal.

10. What is wrong with finding the volume of the pool (Ex. 7) like this: $4 \times 3\frac{1}{4} \times 18$?

11. Find the volume of a storage bin 8′ long, 6′4″ wide, and 30″ deep.

UNITS OF LENGTH	UNITS OF AREA	UNITS OF VOLUME
yard foot inch	square yard square foot square inch	cubic yard cubic foot cubic inch

A completion test on measures

1. To change feet to inches, multiply by _?_.

2. To change square feet to square inches, _?_ by _?_.

3. To change cubic feet to cubic inches, _?_ by _?_.

4. To change a larger unit of measure to a smaller unit of measure, always _?_.

5. To change cubic feet to cubic yards, divide by _?_.

6. To change square rods to acres, _?_ by _?_.

7. To change acres to square miles, _?_ by _?_.

8. To change a smaller unit of measure to a larger unit of measure, always _?_.

9. 288 sq. in. = _?_ sq. ft.

10. 3 acres = _?_ sq. rd.

11. 10,560 ft. = _?_ mi.

12. 132 in. = _?_ ft.

13. 6 sq. ft. = _?_ sq. in.

14. 5,184 cu. in. = _?_ cu. ft.

15. Name the common measures of liquid.

16. Name the common units of dry measure.

17. Name the common measures of weight.

18. Name the common measures of time.

19. $\frac{1}{4}$ ton = _?_ lb.

20. 8 oz. = _?_ lb.

21. 6 min. = _?_ sec.

22. 1 yr. = _?_ days = _?_ mo.

23. 2 bu. = _?_ pk. = _?_ qt.

24. 3 gal. = _?_ qt. = _?_ pt.

25. From 6 A.M. to 6 P.M. is _?_ hr.

26. The area of a rectangle depends upon its _?_ and _?_.

27. The volume of a box depends upon its _?_, _?_, and _?_.

28. One gross equals 144 things; so $\frac{1}{4}$ gross equals _?_ things; $\frac{3}{4}$ gross equals _?_ things.

29. A gross = _?_ doz.

30. If you know that 5,280 feet equal 1 mile, you can find the number of yards in a mile by _?_ 5,280 by 3.

Be your own teacher

This page will help you discover another way to think about fraction divisions. You can use it as a handy way to check divisions.

1. $\frac{8}{3} \div \frac{2}{3} =$ _?_ In this division the dividend and divisor are both *thirds.*

Here are the 8 thirds:

$\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{3}$

How many sets of 2 *thirds* can you make from 8 *thirds?*

$\frac{8}{3} \div \frac{2}{3} = \quad 8 \div 2 =$ _?_

2. How many sets of 5 *twelfths* are there in 10 *twelfths?*

$\frac{10}{12} \div \frac{5}{12} = 10 \div 5 =$ _?_

3. $\frac{7}{12} \div \frac{5}{12} = 7 \div 5 =$ _?_

> When the denominators are the same, fractions may be divided by dividing the numerators.
>
> This is called the *common denominator* method.

4. $\frac{7}{5} \div \frac{2}{5} = 7 \div$ _?_ $=$ _?_

Do the divisions in Exs. 5 and 6 by the *invert the divisor* method. Check by the *common* denominator method.

5. $\frac{7}{8} \div \frac{3}{8}$ $\qquad \frac{10}{3} \div \frac{2}{3}$

6. $\frac{9}{4} \div \frac{3}{4}$ $\qquad \frac{2}{10} \div \frac{8}{10}$

7. Find a way to use the *common denominator method* in an example in which the denominators are not alike, as in $\frac{3}{4} \div \frac{3}{8} =$ _?_
Hint: $\frac{6}{8} \div \frac{3}{8} =$ _?_

8. Make a rule for doing divisions like the one in Ex. 7 by the common denominator method.

9. $\frac{7}{8} \div \frac{1}{2} = \frac{7}{8} \div \frac{4}{8} = 7 \div$ _?_ $=$ _?_

10. Now find $\frac{7}{8} \div \frac{1}{2}$ by the *invert the divisor* method. Compare your answers to Exs. 9–10.

11. $6 \div \frac{3}{4} = \frac{24}{4} \div \frac{3}{4} =$ _?_

Do the divisions in Exs. 12–17 by the *invert the divisor* method. Check by the *common denominator* method.

	a	*b*
12.	$8 \div \frac{2}{3}$	$10 \div 2\frac{1}{2}$
13.	$2\frac{1}{4} \div 3$	$\frac{3}{4} \div \frac{3}{16}$
14.	$\frac{5}{6} \div 2\frac{2}{3}$	$\frac{1}{2} \div 5$
15.	$9 \div \frac{2}{3}$	$\frac{5}{6} \div \frac{3}{4}$

16. How many $\frac{3}{4}$ yd. lengths of rope can be cut from 6 yards of rope?

17. Compare the fraction $\frac{3}{4}$ with the fraction $\frac{1}{2}$ by subtraction.
Compare them by division.

 To the Teacher: See Note 7 on page 310.

Measurement problems

1. Bill's room is 10 ft. long, 8 ft. wide, and $7\frac{1}{2}$ ft. high. Will the Paint Packet above contain enough paint for the walls of his room?

2. The Venetian blind Bill wants for his window sells at 64¢ a square foot. The window is 24 in. wide and 60 in. high.
What will the blind cost?

3. A 4-H Club sold 20 bu. of potatoes in 1-peck bags.
How many bags were needed?

4. Sam has 12 gallons of honey. He sells it at $.90 a quart.
How much does he receive for the honey?

5. Ted's father paid 45¢ for a job which took 20 min. That was at the rate of _?_ an hour.

6. Find the areas of rectangles with these dimensions:
$22'' \times 15''$ $2'6'' \times 15''$ 24 ft.$\times$6 yd.

7. Find the volumes of boxes with these dimensions:
$4'' \times 2\frac{1}{3}'' \times 2\frac{1}{2}''$ $3'6'' \times 3' \times 2'$

8. Change 350 cubic feet to cubic yards. (Carry to two decimal places.)

9. A roll of newsprint paper weighs 1500 lb. A freight car will hold 40 rolls, or _?_ tons.

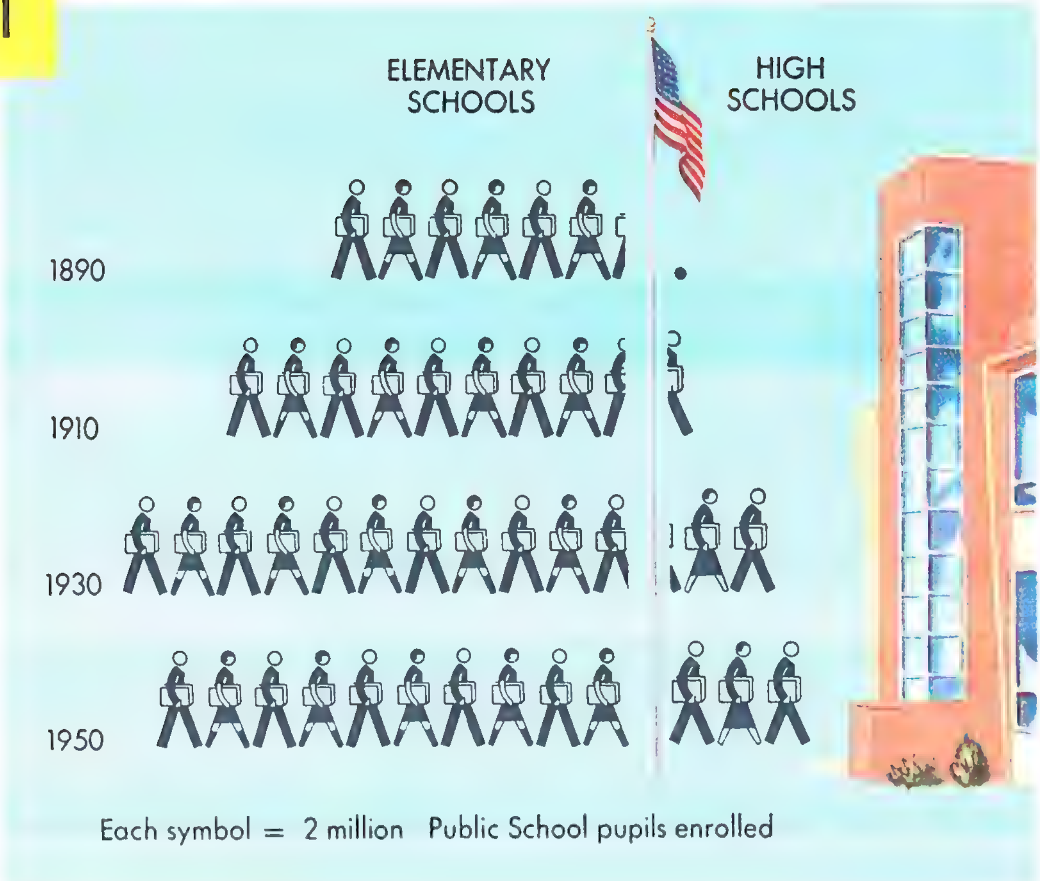
10. How many ounces of candy selling for 60¢ a pound can you buy for 15¢?

11. A certain truck can carry a load of 2.3 cu. yd. How many loads of dirt will the truck cart away from the digging of a foundation $90' \times 24' \times 1'6''$?

12. Which is larger, a deep-freeze locker with inside dimensions of $7\frac{1}{2}' \times 2\frac{1}{2}' \times 1\frac{1}{3}'$, or one with dimensions of $7\frac{1}{2}' \times 2\frac{1}{4}' \times 1\frac{2}{3}'$?

UNIT 31

Pictographs. Bar, line, and circle graphs



Pictographs

A *pictograph* is a way of showing number facts in a picture.

1. In the pictograph above, each picture of a pupil stands for _?_ million pupils.

2. About how many million pupils were there in the public elementary schools in 1890?

3. By 1930 the number of pupils in the public elementary schools had increased to _?_ million.

4. In 1910 the number of pupils in public high schools was less than _?_ million.

5. How many pupils were in public high schools in 1930? 1950?

6. Has the number of pupils in the elementary schools ever decreased? Has the number in high schools ever decreased?

7. Bring pictographs to school for the class to discuss.

Bar graphs

The pupils of the Bayside School are earning money for the March of Dimes.

1. This *bar graph*, which the sixth grade made, shows that so far the third grade has earned _?_ dollars.

2. How much has the fourth grade earned? the fifth grade? the sixth grade?

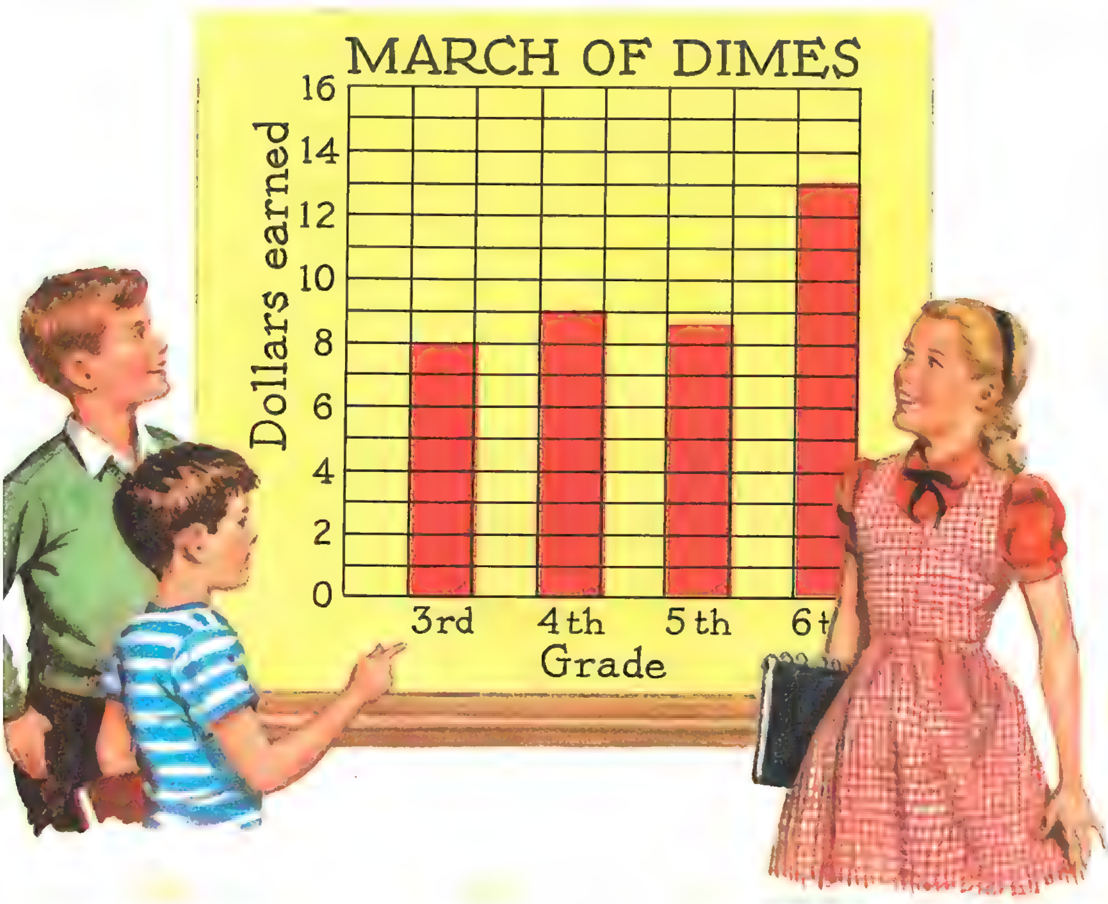
3. If the third grade adds \$2 more today, how will the graph be changed to show this fact?

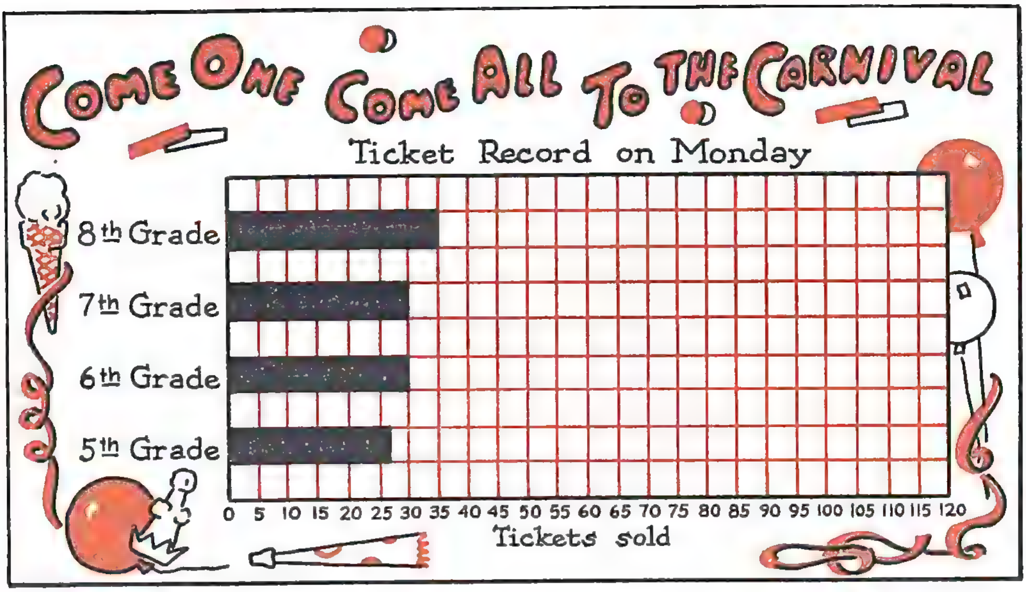
4. How will the graph be changed if the fourth grade adds \$1 more today? if the fifth grade adds \$2 more? if the sixth grade adds $\$1\frac{1}{2}$ more?

5. According to the graph, how much have all four grades earned together so far?

6. Does your class ever make graphs to show facts about school activities?

What suggestions have you for facts your class could show on a graph?





Using bar graphs

The Belmont School is going to give a carnival to raise money for a television set.

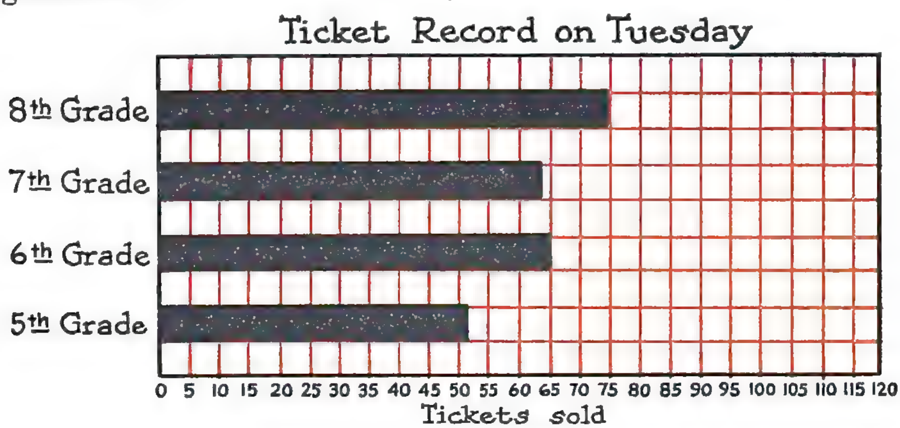
Each day the pupils show on a bar graph in the hall how many tickets each class has sold.

1. Above is the graph for Monday. How many tickets had the 8th grade sold?

2. How many tickets had the 7th grade sold on Monday? How many had the 6th grade sold?

3. How does the graph show that the 5th grade had sold 27 tickets?

The record of sales on Tuesday is shown on the graph below.



4. Which grade had sold the most on Tuesday? How many had that grade sold?

5. The eighth grade had sold _?_ tickets more than the seventh grade, _?_ tickets more than the sixth grade, and _?_ tickets more than the fifth grade.

6. Which grade had sold the smallest number on Tuesday?

The fifth grade had sold _?_ fewer tickets than the sixth grade.

7. By Wednesday morning the eighth grade had sold 100 tickets; the seventh grade had sold 81 tickets; the sixth grade, 97 tickets; and the fifth grade, 73 tickets.

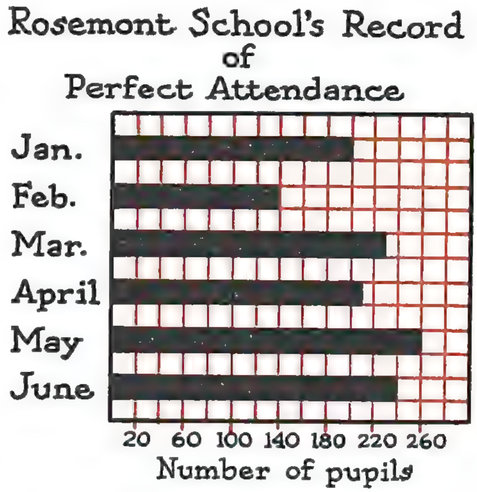
Make a graph to show the record on Wednesday morning. Remember:

- Be sure to give your graph a title.
- How will any person who reads your graph know which bar represents the eighth grade? the seventh grade?
- How will the reader know what the numbers along the bottom of your graph mean?

8. How many tickets had been sold all together by Wednesday?

9. Tickets are selling at 25¢ each. How much money had the school earned for its television set by Wednesday?

10. The television set the school wants costs $179. Had the pupils raised more than half of this amount on their sale of tickets by Wednesday?



11. The graph shows that _?_ pupils in Rosemont School had perfect attendance in January.

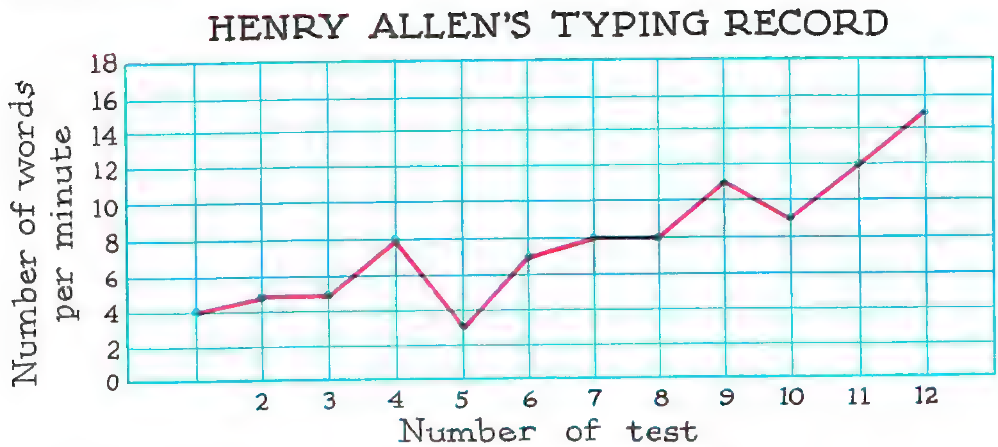
12. How many had perfect attendance during each of the other months?

13. Can you think of any reasons why the number of children with perfect attendance was lowest in February?

14. Look for graphs in newspapers and magazines. See if you can read them. If possible, bring them to school for the class to read.

15. Can you read the graphs in the other schoolbooks you use?

Using line graphs



1. Graphs are pictures that show the relation of numbers.

Do you think they show the relation more clearly and vividly than if the facts were stated in words?

2. Graphs like the one on page 237 are called *bar graphs*, because bars are used to show numbers and their relation.

Why is a graph like the one above called a *line graph?*

3. What is the title of the line graph above? What do the numbers at the bottom show? What do the numbers at the left show?

4. How fast could Henry type at the time of his first test? at the time of his second test? at the time of his twelfth test?

5. Just before the fifth test, Henry hurt his finger.

Does the graph indicate that his hurt finger affected his typing?

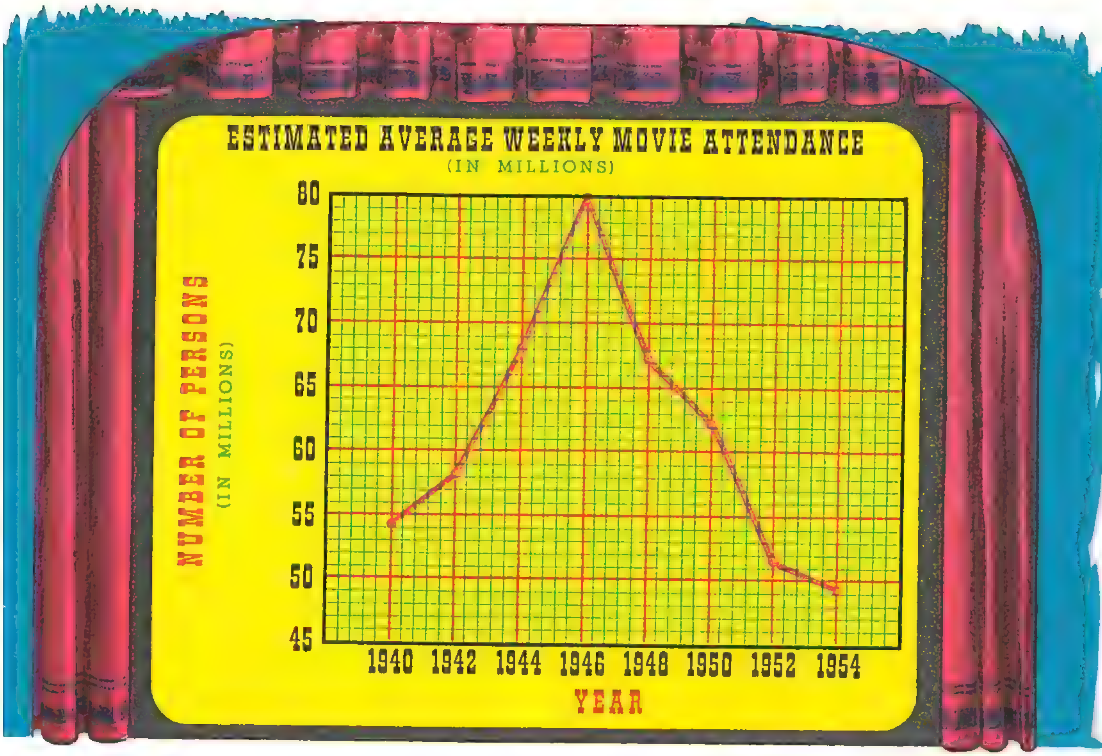
6. Before the tenth test, Henry went on a trip to Chicago.

How does the graph show that his trip affected his record?

7. Below is Martha's typing record on 12 tests. Make a line graph to show the facts.

MARTHA ALCOTT'S TYPING RECORD

Test	1	2	3	4	5	6	7	8	9	10	11	12
Words typed per minute	3	5	7	6	9	10	10	13	11	14	15	16



Reading a graph

1. This graph shows average weekly movie attendance in 1940 estimated at _?_ million.

2. What was the average weekly movie attendance in 1942? 1944? 1946? 1948? 1950? 1954?

3. The weekly movie attendance increased from the year _?_ to the year _?_.

4. Since 1946 the weekly movie attendance has _?_.

5. Can you tell from the graph that average weekly attendance will continue to decrease?

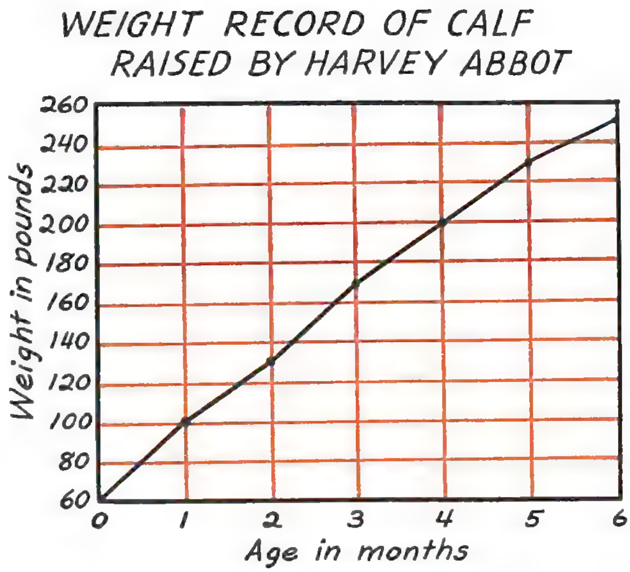
6. Can you tell from the graph anything about the average weekly movie attendance before 1940?

7. Does the graph say that exactly 54 million people went to the movies each week in 1940?

8. Which of the following do you think might be causes of the falling off of movie attendance?

- Increased use of television
- Increased use of radio
- People tired of going to the movies
- Admission price too high
- Objection of young people to staying out so late

Graphs



1. Harvey is a 4-H Club member. His project this year is raising a calf. He made the line graph shown here, in order to keep a record of his calf's growth in weight.

How much did the calf weigh at the age of 1 month? 2 months? 3 months? 4? 5? 6?

2. Make a table showing the facts about Harvey's calf that you can learn from the graph.

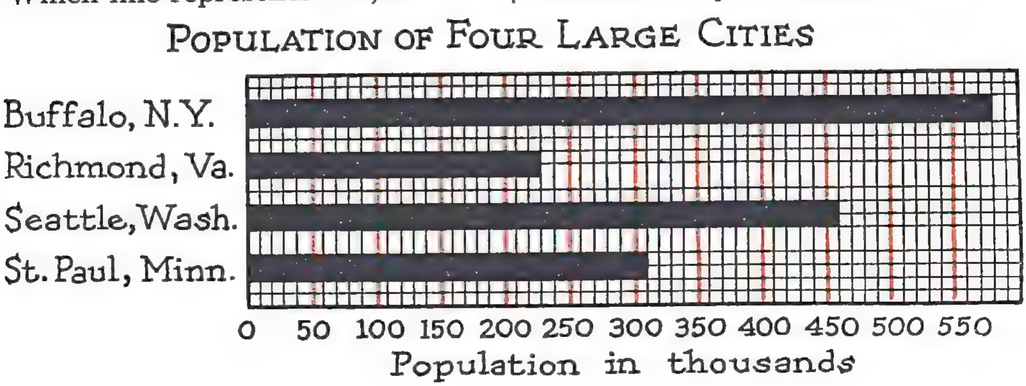
3. What does the bar graph at the bottom of the page show? Name the four cities in the order of size.

4. The figures along the bottom of the graph below tell the number of thousands; so 50 means 50,000; 100 means 100,000; etc. Which line represents 110,000?

5. You can tell at a glance that Buffalo is the largest of these cities. What is its population?

Read on the graph the population of the other cities. About how many persons were there in each of the cities?

6. Are the numbers shown in this graph round numbers? Give a reason for your answer.



Tables and graphs

TABLE OF GASOLINE PRICES

Number of gallons sold	1	2	3	4	5	6	7	8	9	10
Price	\$.30	\$.60	\$.90	\$1.20	\$1.50	\$1.80	\$2.10	\$2.40	\$2.70	\$3.00

John sometimes helps sell gasoline at his father's filling station. He made the table above to help him know how much to charge for any number of gallons of gasoline.

1. The table shows that for 1 gallon of gasoline John charges _?_.
How much does he charge for 2 gal.? 3? 4? 5? 6? 7? 8? 9? 10?

2. How many gallons of gasoline should he give for \$.90? \$1.20? \$2.10? \$3.00?

3. If he extends the table up to 12 gallons, how will it look?

4. How can he figure from the table how much to charge for $4\frac{1}{2}$ gal.? $5\frac{1}{2}$ gal.? $8\frac{1}{2}$ gal.?

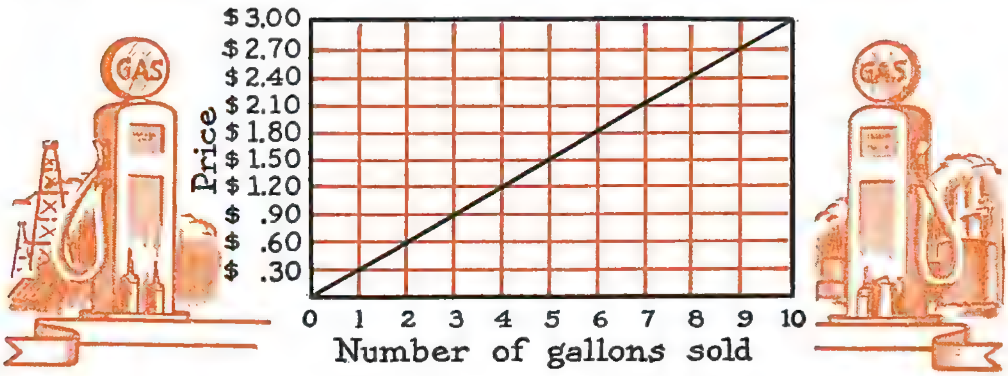
5. Instead of a table of gasoline prices John could have made a graph like the one below.
According to the graph how much should he charge for 1 gal.? 2? 3? 4? 5? 6? 7? 8? 9? 10?

6. Show on the graph how many gallons of gasoline he should give for \$.90; for \$1.80; for \$2.40.

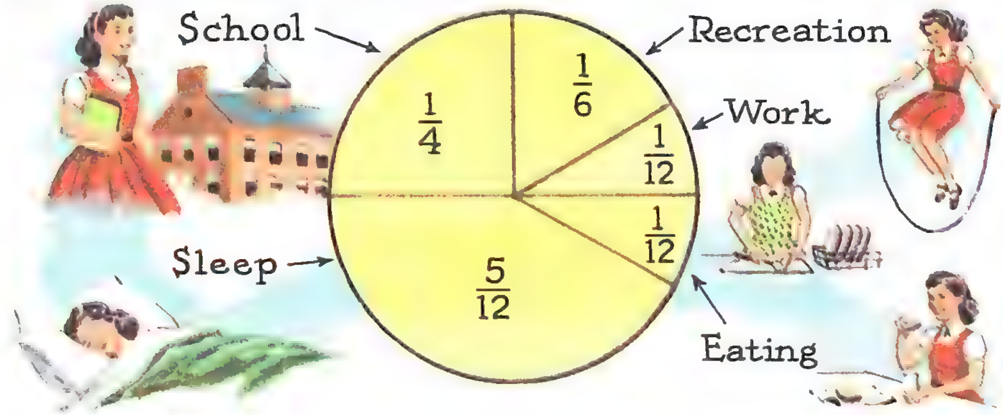
7. How can he use the graph to find how much to charge for $4\frac{1}{2}$ gal.? $6\frac{1}{2}$ gal.? $8\frac{1}{2}$ gal.?

8. Use the graph to find how many gallons to give for \$.75; \$1.35; \$2.25; \$2.85.

9. If you were John, which would you rather use to help in selling gasoline, a table or a graph?



HOW PATRICIA SPENDS HER TIME ON A SCHOOL DAY



A circle graph

This circle represents the 24 hours in Patricia's day.

The parts of the circle show what fractional part of the day Patricia spends in each of various activities.

A circle like this is called a *circle graph.*

1. What different things does Patricia do during a school day?

2. What part of the day does she spend in sleeping? What part in eating? in school? in recreation? in working?

3. Does the graph show she spends half her time sleeping and eating?

4. How does the time that Patricia spends eating compare with the time that she spends working?

5. Does she spend twice as much of her time at play as she spends at work when she is not in school?

6. The fractional parts of the circle show the different ways Patricia uses her time.

Do the parts add up to a whole?

$$\frac{5}{12} + \frac{1}{12} + \frac{1}{12} + \frac{1}{6} + \frac{1}{4} = \frac{?}{12}$$

7. There are 24 hours in a day. How many hours each day does Patricia spend sleeping? in school? in recreation? in working? in eating?

8. Look in newspapers and magazines for circle graphs. Study them and see if you understand the stories they tell.

If possible, bring some of these circle graphs to school for the class to see.

Problem solving. Practice in thinking with numbers. Maintenance

UNIT 32

Buying a food freezer

Mrs. Martin is thinking of buying the freezer shown below. Here are some facts about the freezer:

Regular price (cash): \$284.25
Sale price (cash): \$262.50
Delayed-payment price: \$25.50 down, \$11 monthly for 24 months
Outside dimensions of freezer: 29 in. by $53\frac{1}{2}$ in. by $39\frac{3}{4}$ in.
Storage space dimensions: 20 in. by $44\frac{1}{2}$ in. by 18 in.

1. How much has the cash price been reduced for the sale?

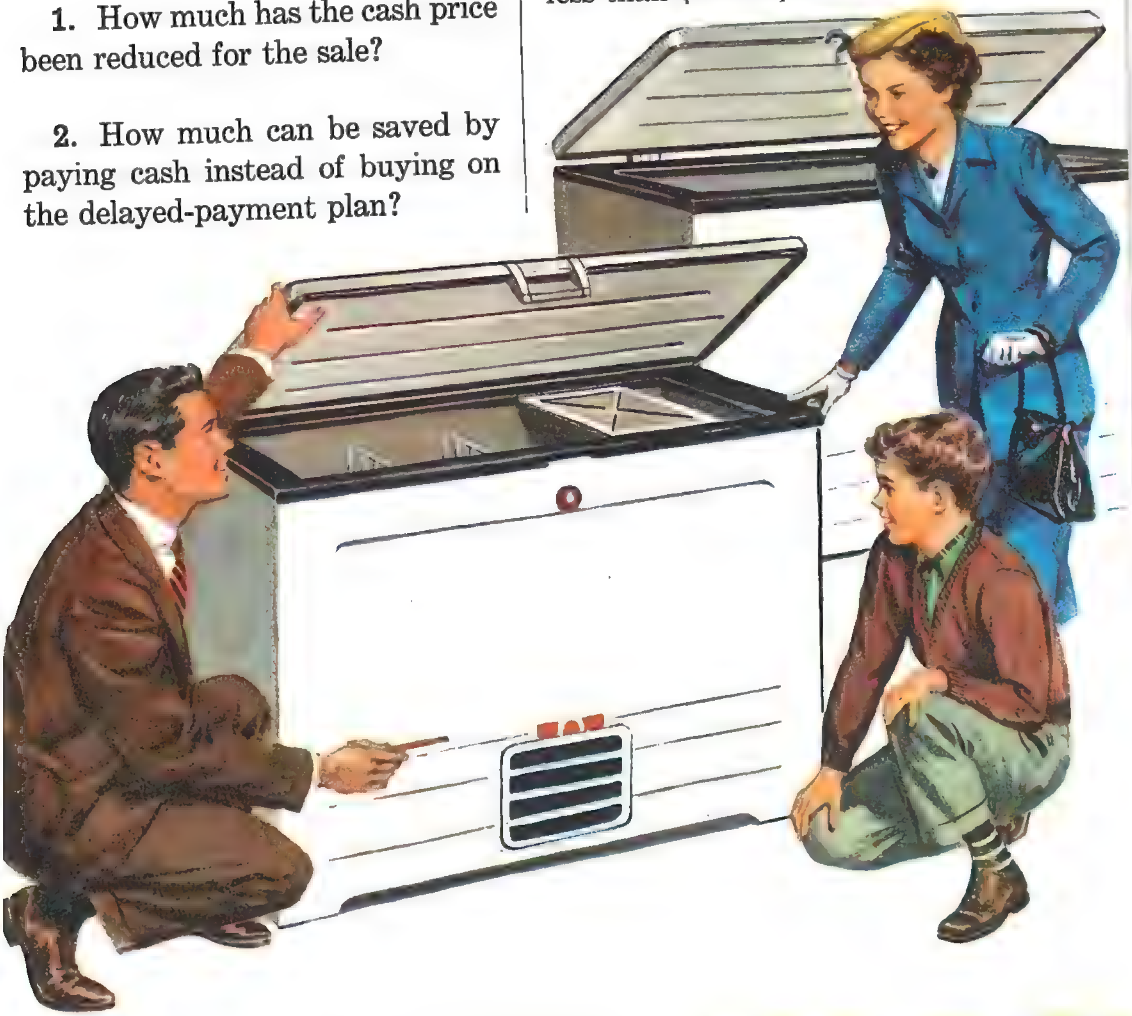
2. How much can be saved by paying cash instead of buying on the delayed-payment plan?

3. The Martins' back door is 30″ wide. Could they get the freezer through the back door?

4. How many cubic inches of space are there in the freezer?

5. The salesman says the freezer has 9.3 cu. ft. of space. Does that agree with your answer to Ex. 4?

6. Check the salesman's statement that the storage space costs less than \$28.23 per cubic foot.



Estimating quotients

1. Seventeen pupils spent \$5.94 for a picnic. They want to share the cost equally. To estimate each share, Bud thought:

- "Each should pay more than 10¢, because 17 × 10¢ is only _?_.
- "Each should pay more than 20¢, because 17 × 20¢ is only _?_.
- "Each pupil should pay between 30¢ and 40¢." Why?
- "I estimate that each pupil's share of the cost is 35 cents. Four of us would pay \$1.40, 16 of us would pay 4 times \$1.40, or \$_?_. The 17th one would pay 35¢, and that would make \$_?_ in all.

"If we pay 35 cents each, we'll have _?_¢ more than we need."

2. Estimate each pupil's share of the cost of a picnic if 19 pupils spend \$7.90 in all.

3. Estimate each pupil's share of the cost of a picnic if 23 pupils spend \$7.34 in all.

4. Ted said that the quotient in $24\overline{)\$9.50}$ is less than \$.50. How could he tell that?

"It's not as much as 40 cents," he said. How could he tell that?

5. To the nearest cent, the quotient in $24\overline{)\$9.50}$ is _?_.

6. Charles said that the quotient in $9\overline{)7189}$ is a three-figure number, just a little less than 8 hundred. How could he tell that?

7. Is the quotient in this division a one-, a two-, or a three-figure number? How do you tell?

$\boxed{29\overline{)2600}}$

8. In Ex. 7, Susan said that the first figure of the quotient was probably $\frac{26}{3}$, or 8.

She rounded off the divisor to _?_. Complete the division.

9. Would 100 be a sensible quotient? Estimate it.

$\boxed{19\overline{)1000}}$

10. To estimate the first quotient figure in Ex. 9, Joe got a hint by dividing 100 by 20.

Complete the division.

11. To estimate the quotient in $16\overline{)1000}$, Bob thought, "In 100 there are about six 16's. So in 1000 there are about _?_ 16's."

Complete the division.

12. To estimate in $\$.34\overline{)\$8.97}$, think, "In \$1 there are about three \$.34's. In 9 dollars there are about _?_ \$.34's."

Do the division.

13. Give some illustrations of good ways to estimate quotients.

Practice in thinking

1. Without multiplying, tell which is more: $24 \times 5¢$, or $6 \times 24¢$.

2. Would $1\frac{1}{2} \times 3\frac{1}{4}$ equal $2\frac{7}{8}$, or $4\frac{7}{8}$, or $8\frac{7}{8}$?

3. Would 4.6×12.87 equal 592.02, or 5.9202, or 59.202?

4. The scale of a certain map is 1 inch to 20 miles.

Tell the distance between two towns that are the following distances apart on the map:

1 in.	$1\frac{1}{2}$ in.	$1\frac{1}{4}$ in.	$2\frac{1}{2}$ in.
$\frac{3}{4}$ in.	$2\frac{3}{4}$ in.	$1\frac{1}{8}$ in.	$2\frac{3}{8}$ in.

Find the areas of rectangles of these dimensions:

	a	*b*	*c*
5.	3 ft. by 3 ft.	2 ft. by 9 ft.	1 ft. by 9 ft.
6.	3 yd. by 2 yd.	$2\frac{1}{4}$ yd. by 4 yd.	$1\frac{1}{2}$ yd. by 3 yd.
7.	1 ft. by 1 yd.	2 ft. by 3 yd.	$1\frac{1}{2}$ yd. by 3 ft.

Find the volumes of boxes of these dimensions:

8.	$1''$ by $1''$ by $1''$	$2'$ by $3'$ by $4'$	$6'$ by $8'$ by $10'$
9.	$4''$ by $5''$ by $2\frac{1}{2}''$	$8'$ by $6'$ by $2'$	$10'$ by $10'$ by $12'$
10.	$2''$ by $2\frac{1}{2}''$ by $1\frac{1}{2}''$	$3'$ by $\frac{2}{3}'$ by $4'$	$10'$ by $4'$ by $2\frac{3}{4}'$

Exs. 11 and 12 are done for you. Do Exs. 13 and 14 the same way.

11. $15 \times 12¢ = (10 \times 12¢) + (5 \times 12¢) = \$1.20 + \$.60 = \$1.80$

12. $9 \times 43¢ = (9 \times 40¢) + (9 \times 3¢) = \$3.60 + \$.27 = \$3.87$

	a	*b*	*c*	*d*
13.	$15 \times 13¢$	$17 \times 12¢$	$14 \times 15¢$	$8 \times 27¢$
14.	$9 \times 42¢$	$8 \times 34¢$	$7 \times 43¢$	$6 \times 27¢$

Watch the signs!

15.	$\frac{3}{4} + \frac{3}{8}$	$4 - 1\frac{1}{2}$	$2\frac{5}{8} \div 4\frac{1}{2}$	$\frac{1}{10}$ of $\frac{1}{10}$
16.	$1 \div .1$	$1 \div .01$	$1 \div .001$	$\frac{1}{10}$ of $\frac{1}{100}$

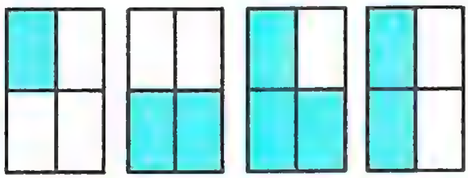
A page of practice

1. Which of these equal 1.25?

$\frac{125}{100}$ $\quad 1\frac{1}{4}$ $\quad \frac{25}{100}$ $\quad \frac{5}{4}$ $\quad 1\frac{25}{100}$

2. If you divide 12,474 by 27, will the quotient be a 1-figure, a 2-figure, or a 3-figure number?

3. In which box is .75 colored?



4. Estimate the area of the top of your desk in square feet.

5. Write the next two numbers in these series:

a)	1	1.5	2.0	?	?
b)	.25	.50	1.00	?	?
c)	100	10	1	?	?
d)	8	4	2	?	?

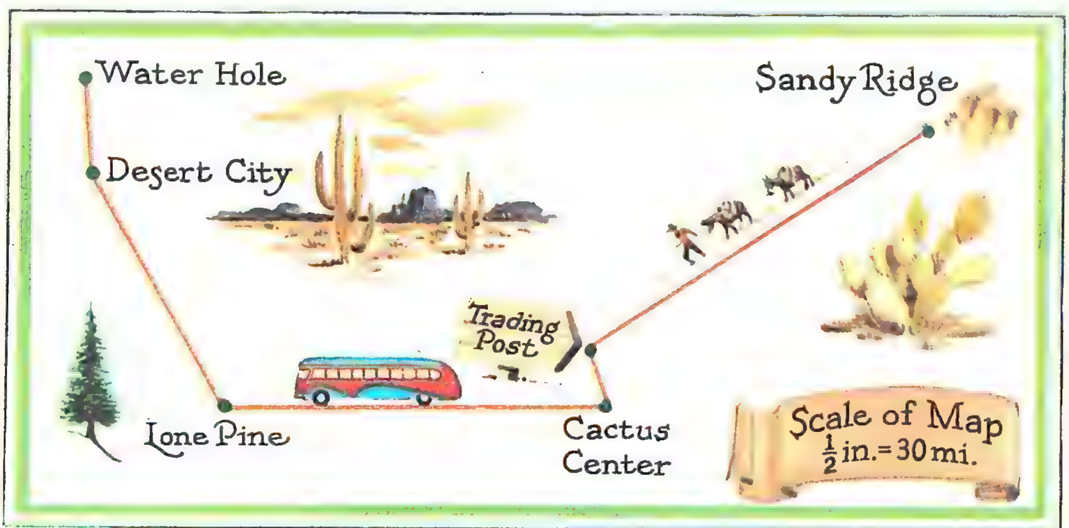
6. Make a line graph that will show the following daily temperatures:

6 A.M., 42°	10 A.M., 47°
7 A.M., 43°	11 A.M., 48°
8 A.M., 45°	Noon, 60°
9 A.M., 45°	1 P.M., 51°

7. What scale was used in drawing the picture map shown at the bottom of the page?

8. Use the map below to find the distance by road between these places:

a) Water Hole and Desert City
b) Desert City and Lone Pine
c) Lone Pine and Cactus Center
d) Cactus Center and Trading Post
e) Trading Post and Sandy Ridge
f) Water Hole and Cactus Center
g) Sandy Ridge and Lone Pine



Arithmetic roundup

▶ Oral review

1. Is 24.7×8.6 about 702 or 112 or 212?

2. Is $232.7 \div 6.5$ about 36 or 26 or 46?

3. Which one of these does not equal the others?

$\frac{3}{10}$ $\quad 10\overline{)3}$ $\quad .3$ $\quad .30$ $\quad 3\overline{)10}$

4. Jim has a sheet of cardboard divided into 10 equal pieces. If Bill cuts each piece into 10 equal pieces, will each small piece be .1, .01, or .001 of the whole sheet?

5. Change to common fractions reduced to lowest terms:

.7 $\quad$ .4 $\quad$ .60 $\quad$ .35 $\quad$ .05 $\quad$ .40

6. Read these amounts in order of size, beginning with the largest:

.576 $\quad$ .8 $\quad$ $.65\frac{1}{2}$ $\quad$ .09 $\quad$ .61

7. Express to the nearest tenth:

.82 $\quad$ .78 $\quad$ .452 $\quad$ .912

8. The area of a rectangle $12' \times 9'$ is _?_ sq. yd.

9. Multiply \$4.45 by 10; by 100; by 1000.

10. Divide \$242 by 10; by 100; by 1000.

11. At the rate of 50¢ for 100 lb. of ice, 50 lb. of ice will cost _?_¢; 20 lb. will cost _?_¢.

▶ Written review

1. $32.6 + .65 + 19.72 + .7$

2. How much must be added to 26.55 to make 60.17?

3. $3\frac{3}{4} + \frac{1}{3} + \frac{1}{6}$

4. $5\frac{3}{8} \times 20$

5. $16 - 1\frac{1}{5}$

6. $3\frac{1}{3} \div 2\frac{1}{2}$

7. $18 \div 2\frac{2}{5}$

8. 40.6×7.08

9. Carry the quotient to two decimal places: $75\overline{)24.6}$

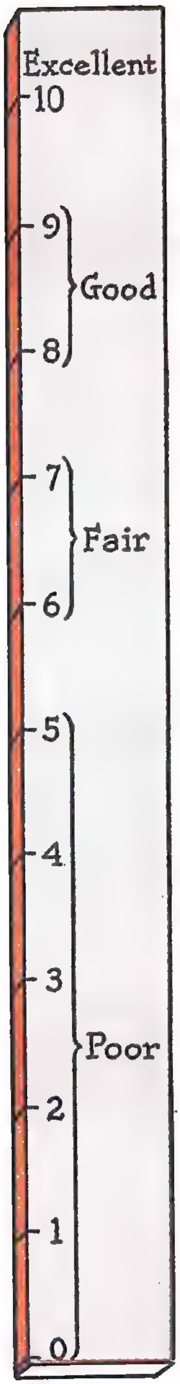
10. Bill needs to frame a map 30″ by 24″. How many feet of wood must he get if he allows 1 foot extra for corners?

11. Find the average of 10.75, 6.80, and 8.25.

12. Blue pencils cost \$8.64 a gross (144), or _?_ per pencil.

13. Make a line graph of your scores on Problem Tests 1–5.

Problem Test 6



Measure your growth in problem solving.

1. The record at Franklin School for the 220-yard dash is 28.4 sec. Jerry ran it in 29.3 sec., or _?_ tenths second over the record time.

2. At \$2.75 a yard, how much will Leonard pay for $3\frac{1}{2}$ yd. of artificial leather?

3. Ann's birthday cake recipe calls for $3\frac{1}{2}$ cups of flour. How much flour should Ann use in making $\frac{1}{2}$ of the recipe?

4. Arthur sold 32 chickens for \$59.84. If they weighed $4\frac{1}{4}$ lb. on the average, he sold them at _?_¢ a pound.

5. Sue's father bought her a book of 50 bus tickets. Sue uses two tickets a day for school. How many weeks of school days should the book last?

6. Jane is putting paper on 4 shelves each 18 in. long. She has two 3-foot rolls of paper. Has she enough?

7. Find the perimeter of a rectangle $20' \times 10'\,6''$.

8. Jack rode from Oxford to Lockport, a distance of 24 miles, in 3 hr. Louis rode from Greenville to Lockport, a distance of 28 mi., in 4 hr. How many miles an hour faster did Jack ride?

9. How much change should Jim get from a 5-dollar bill if he buys sunglasses for \$1.98 and 4 pairs of socks at 2 pairs for 39¢?

10. The Miller family's milk bill during April was \$17.10. They pay 19¢ a quart for their milk.

The Millers drank an average of _?_ qt. of milk a day during April.

Write your score on your Problem Test Record.

Thinking about fractions

Make up and solve a problem in which you use each of the following:

1. A proper fraction plus a proper fraction

2. A proper fraction plus an improper fraction

3. A mixed number plus a mixed number

4. A mixed number plus a proper fraction

5. A proper fraction minus a proper fraction

6. A whole number minus a proper fraction

7. A mixed number minus a proper fraction

8. A mixed number minus a mixed number

9. A whole number minus a mixed number

10. A whole number times a proper fraction

11. A whole number times a mixed number

12. A proper fraction times a whole number

13. A proper fraction times a mixed number

14. A proper fraction times a proper fraction

15. A mixed number times a proper fraction

16. A mixed number times a mixed number

17. A whole number divided by a fraction

18. A proper fraction divided by a proper fraction

19. A mixed number divided by a proper fraction

Tell whether the following statements are ***never true, sometimes true,*** *or* ***always true:***

20. A proper fraction plus a proper fraction is a proper fraction.

21. An improper fraction plus an improper fraction is greater than 2.

22. The quotient of a whole number divided by a fraction is greater than the whole number.

23. The quotient of a fraction divided by a whole number is smaller than the fraction.

24. The quotient of a mixed number divided by a mixed number is a mixed number.

Self-Help Test 11

1. $\begin{array}{r} 462.8 \\ 17.0 \\ 9.8 \\ 105.0 \\ \underline{57.6} \end{array}$ (173)

2. $65.2 - 18.7$ (174)

3. $6.8 \times \$20.25$ (186)

4. $\$15 - \$6.47$ (174)

5. $6.8\overline{)548.08}$ (203)

6. 87.9×8.06 (186)

7. $17\overline{)103.19}$ (198)

8. $4\frac{1}{5} + 1\frac{1}{2}$ (68)

9. $8 - 1\frac{1}{4}$ (70)

10. $3\frac{1}{6} - \frac{3}{4}$ (72)

11. $6\frac{4}{9} \times 6$ (95)

12. $2\frac{2}{3} \times \frac{1}{10}$ (110)

13. $5\frac{1}{3} \times 1\frac{1}{2}$ (111)

14. $9 \div \frac{2}{3}$ (130)

15. $12 \div 3\frac{1}{3}$ (133)

16. $\$4.80 \div 1\frac{1}{2}$ (135)

17. Write in figures: Twenty and seventy-five thousandths. (89)

18. Express as common fractions in lowest terms:

.15 .4 .075 .28 (157, 161)

19. Express to the nearest hundredth: .865 .017 (209)

20. How many cu. in. are there in a box $6'' \times 4'' \times 2\frac{1}{2}''$? (230)

21. If you know the rate at which a train travels and the number of hours it takes, how do you find the distance it goes? (99)

22. Seven piles of old newspapers weigh 115.2 lb., 96.8 lb., 104.5 lb., 98.7 lb., 104.2 lb., 92.8 lb., and 85.0 lb.

What is the average weight of the piles? Give your answer to the nearest pound. (54)

Self-Help Test 12

1. Express to the nearest cent: \$.068 \$.022 (209)

2. How many square feet are in a windowpane $2\frac{2}{3}'$ by $2\frac{1}{4}'$? (222)

3. When $\frac{1}{4}$ in. on a map stands for 5 mi., a line 1 in. long stands for _?_ mi. (150)

4. What is the average rate in miles per hour of an express train which travels a distance of 329.5 mi. in 4.5 hr.? Give your answer to the nearest mile. (100)

5. How many acres are there in a cornfield 20 rd. long and 18 rd. wide? (224–225)

Self-Help Test 13

1. 9.5×146.8 **(186)**
2. $10\frac{1}{3} - 3\frac{7}{12}$ **(72)**
3. $6\overline{).012}$ **(198)**
4. $\frac{1}{4} \div 3$ **(137)**
5. $16 - 6\frac{5}{8}$ **(70)**
6. $3.690 \div 24.6$ **(203)**
7. $\frac{3}{5} \div \frac{3}{4}$ **(136)**
8. $\frac{3}{5} + 1\frac{3}{4}$ **(68)**
9. $645 \div 100$ **(205)**
10. $\frac{5}{6}$ of $\frac{3}{5}$ **(90)**
11. $6\frac{9}{10} + \frac{1}{2}$ **(68)**
12. 100×86.7 **(191)**
13. $8 \times \frac{3}{5}$ **(86)**
14. $\frac{5}{6} \div 1\frac{1}{2}$ **(142)**
15. $6\frac{2}{3} \div \frac{1}{6}$ **(140)**

Self-Help Test 14

1. Write in figures: 6 thousand and 6 thousandths. **(164)**

2. Which of these numbers is larger, 23.3 or 23.03? How much larger? **(162–163)**

3. What is the sum of $8\frac{5}{8}$, $1\frac{3}{4}$, and $\frac{5}{16}$? **(68)**

4. $5\frac{2}{3}$ is how much less than $16\frac{1}{4}$? **(72)**

5. Express to nearest tenth:

.62 .08 .43 .86 **(209)**

6. Divide 525 by 60 and carry the quotient to two decimal places. Express the answer to the nearest tenth. **(209)**

7. $\begin{array}{r} 24 \\ \times\ 16\frac{2}{3} \\ \hline \end{array}$ **(95)**

8. $\begin{array}{r} 18\frac{2}{5} \\ \times\ 2 \\ \hline \end{array}$ **(115)**

9. $\begin{array}{r} \$4.00 \\ \times\ 2\frac{7}{8} \\ \hline \end{array}$ **(96)**

10. $\begin{array}{r} .05 \\ \times\ 6 \\ \hline \end{array}$ **(186)**

11. Write these chapter numbers in figures: CXIV, LXIX, XLIX. **(102–103)**

12. Jack's rabbit run is 20 ft. by 12 ft., and Bill's run is 16 ft. square. What is the perimeter of each run? **(120)**

13. It takes $7\frac{1}{2}$ gal. of water to fill a cubic foot of space. How many gallons of water will a tank $3' \times 4' \times 5'$ hold? **(230)**

14. If the decimal point in 4.756 were moved two places to the right, the number would be _?_ times as large. **(191)**

15. If the 3 in each of these numbers were changed to a 4, then which number would be increased the most in value?

325 32.5 3.25 .325 **(166)**

16. Is $\frac{1}{2}$ nearer .48 or .53? **(161)**

Measuring your growth in arithmetic

Copy the examples correctly. Work carefully. Check your answers. Be sure your answers are sensible.

1. If the scale of a map is $\frac{1}{8}''$ to 25 mi., how long a distance is represented by a line $1\frac{1}{8}''$ long?

2. Using a scale of $\frac{1}{2}''$ to $10'$, draw a rectangle to represent a house lot $100'$ long and $50'$ wide.

3. 36 sq. ft. = ? sq. yd.
   $2\frac{1}{2}$ acres = ? sq. rd.

4. Find the area of a rectangle $12\frac{1}{4}''$ by $8''$.

5. A tennis court is 26 yd. by 12 yd. How much will Hal receive for rolling it at 2¢ a square yard?

6. How many acres are there in a lot 1.5 mi. × .5 mi.?

7. At 12¢ a square foot, how much will it cost to paint and shellac a floor which is $12'\ 4''$ long and $7'\ 6''$ wide?

8. A box $6'' \times 3\frac{1}{2}'' \times 2\frac{1}{3}''$ contains ? cubic inches.

9. Pete is digging a goldfish pond $8' \times 9' \times 3'\ 4''$. How many cubic feet of soil will he need to remove?

10. A circle graph shows that $\frac{7}{8}$ of the 328 pupils in Lakeside School belong to the Junior Red Cross.
    How many pupils belong? How many pupils do not?

Just for fun

1. What is the difference between one half a square yard and a half-yard square?
   Maybe you will need to make a drawing to help you.

2. Use 6 matches to form the fraction $\frac{1}{7}$.
   By moving just one match change the fraction so that its value is one third.

3. Jim started from home to school one day with his dog, Jip. Jim walked at the rate of 3 miles an hour. Jip trotted ahead at 6 miles an hour.
   On reaching the school, which was a mile from Jim's home, Jip trotted back at the same rate until he met Jim.
   How far from home was Jim when Jip met him?

Howard's lawn-mowing

1. On April first, Howard bought a power lawn mower. He paid $15 down, and agreed to pay $14 a month for 6 months.

The total price of the mower was _?_.

2. Before Howard had the power mower, he charged 75¢ an hour for cutting lawns. After he had it, he charged $1.50 an hour.

He claimed that the power mower saved money for his customers. How did he figure that?

Here is Howard's record of the number of hours he and his power mower worked from April through October:

April	10 hr. 45 min.
May	15 hr. 15 min.
June	20 hr. 40 min.
July	28 hr. 30 min.
August	32 hr.
September	18 hr. 10 min.
October	9 hr. 40 min.

3. How much money did Howard take in during April?

How much did he take in during each of the other months?

4. How much more than the 14-dollar monthly payment did Howard take in during April? during each of the other months?

5. When did Howard make his last 14-dollar payment?

6. Howard said his October income almost paid him back the 15-dollar down payment he made in April. Explain.

7. The mower ran an average of 5 hours on 1 qt. of gasoline.

At 24¢ a gallon, figure the cost of the gasoline Howard used during the season.

8. How much more did Howard take in during the season than he paid for the lawn mower and gasoline?

To the Teacher: See Note 8 on page 310.

153 Woodlawn Avenue
Middletown, Illinois
April 5, 195-

Center Sport Shop
153 Main Street
St. Louis, Missouri

Gentlemen:

Please send me:

3 baseballs @ \$.85	\$2.55
2 baseball bats @ \$1.10	
1 catcher's mask @ \$3.60	
Total	

Yours truly,
Richard Davis
Mgr. Spitfires

Meeting club expenses

1. Dick is manager of the "Spitfires," a baseball club. Find the total cost of his order above.

2. The team voted also to get suits and caps. At \$3.25 for a suit and \$.35 for a cap, how much would outfits for the 12 boys in the ball club cost?

3. With \$3.00 for unexpected expenses, how much did the boys figure they needed in all?

4. Six boys said they could earn these amounts in a week:

Philip	\$1.75	Ted	\$1.00
Bill	2.25	Charles	2.70
Gene	1.50	Jay	2.20

Find the average amount they estimated they could earn per boy.

5. If a boy earned \$1.90 a week and gave half to the club, how much would the club get?

If each of 12 boys gave \$.95 per week to the club, how much would the club receive in one week?

6. If each of 12 boys gave \$.95 per week, how many weeks (to the nearest whole number) would it take to get the \$54.55 for the uniforms and supplies?

Could the boys earn the \$54.55 between April 15 and May 15?

7. Philip offered to print handbills to tell people what kind of odd jobs the boys would do.

How many handbills did Philip need to print, if each of the 12 boys was to distribute 50 copies?

Earning money for the club

1. Jack raked leaves for Mrs. Burns for $2\frac{1}{2}$ hours at 40¢ an hour. She paid him $\underline{?}.

Jack kept half the money, or _?_¢, and gave _?_¢ to the club.

How much should a boy earn who works:

2. $1\frac{1}{2}$ hr. at 20¢ an hour? at 30¢ an hour? 40¢? 50¢? 60¢?

3. 2 hr. and 15 min. at 20¢ an hour? at 40¢ an hour? 60¢?

4. 1 hr. and 40 min. at 15¢ an hour? at 30¢ an hour? 45¢?

5. 3 hr. and 45 min. at 20¢ an hr.? at 40¢ an hour? 60¢?

6. Mrs. Stuart gave Charles $1.00 for some odd jobs.

Charles worked $2\frac{1}{2}$ hours. How much did he earn an hour?

7. Mrs. Walton gave George 25¢ for work that took 20 min. The rate was _?_ an hour.

Find the rate per hour:

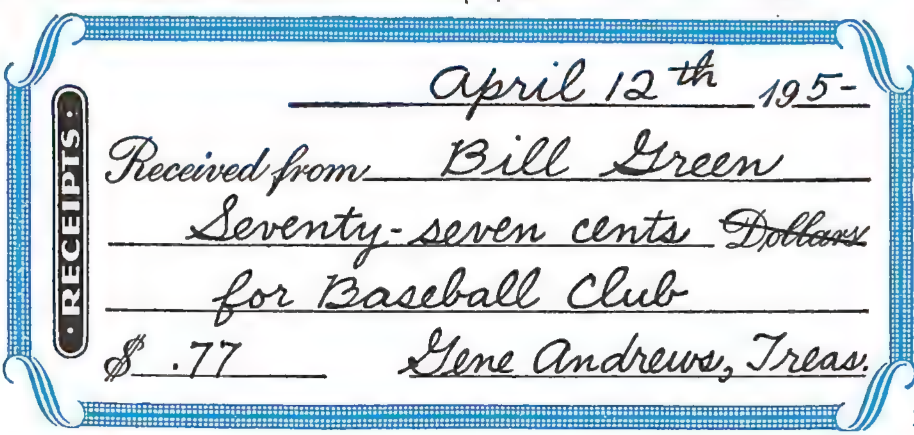
	a	*b*
8.	20¢ in 10 min.	50¢ in $2\frac{1}{2}$ hr.
9.	25¢ in 30 min.	40¢ in $1\frac{1}{3}$ hr.
10.	15¢ in 20 min.	60¢ in $1\frac{1}{5}$ hr.

11. When Bill Green turned in his money at the club meeting, the treasurer, Gene, took it and counted it. Then he made out a ***receipt*** and gave it to Bill.

Look at Bill's receipt at the bottom of the page. How much money did he turn in? What was the date of the meeting?

12. Gene kept a copy of this receipt in his receipt book. Why?

13. When all the money had been turned in, Gene had these amounts entered in his receipt book: 77¢, 75¢, 50¢, 38¢, 45¢, 63¢, $1.38, 60¢, 33¢, 95¢, 79¢, $1.24. Find the total.


RECEIPTS

April 12th 195-

Received from Bill Green

Seventy-seven cents ~~Dollars~~

for Baseball Club

$ .77 Gene Andrews, Treas.

Keeping a record of club money

Money Received				Money Spent			
Apr. 12	Club Members	8	77	Apr. 13	1 baseball		85
					1 heavy bat	1	25
					1 light bat		85
					4 gloves	2	00
					1 catcher's mask		75
					Paper and ink		35
				Apr. 18	Cash on hand	2	72
	Total	8	77		Total	8	77

After the club meeting, Gene prepared the ***account*** shown above. It is a record of money received and spent during a week.

1. How much money did Gene receive from the club members? On what date did he receive it?

Did the club receive any other money?

2. On what date did Gene spend money? What did he buy? How much money did he spend?

3. Did Gene receive more than he spent? How much more?

4. How much money did Gene have "on hand" on April 18?

At the bottom of the page you can see how Gene's account looked a week later.

5. Explain what Gene meant by "Cash brought forward."

6. How much did Gene receive from club members on April 19?

7. How much money did Gene spend on April 20?

8. How much money did Gene have "on hand" on April 25?

Money Received				Money Spent			
Apr. 19	Cash brought forward	2	72	Apr. 20	2 head guards	2	50
	Club Members	22	96		2 chest guards	1	50
					4 bases	1	00
				Apr. 25	Cash on hand	20	68
	Total	25	68		Total	25	68

A money account is said to be in *balance* when:

Cash brought forward
plus
total amount received
equals
total spent + cash on hand

9. If an account is kept correctly, should it always balance?

10. Make out the third week's account for Gene.

- On April 26, cash brought forward: \$20.68
- On April 27, received from club members: \$14.28
- On April 28, spent: for caps, \$3.00; for suits, \$30.00
- On April 30 Gene counted his cash on hand. He had \$1.96.

Does the account balance?

At the close of the baseball season the Spitfires gave a picnic. Below is the *bill* for picnic supplies. The sign @ means "at," and means the cost of one.

11. Gene found he had not been charged for 3 lb. of bananas @ 15¢ a pound.

After the error was corrected, what was the total of the bill?

12. After Gene corrected the bill and paid it, the cashier stamped the bill "Paid."

Gene kept the *receipted bill* with his club records.

13. Maybe you can bring a receipted bill to school.

Try to get a bill that has several items. Check the arithmetic.

MARKET SQUARE GROCERY

Middletown, Ill.

Sold to: Spitfires Baseball Club
Gene Andrews, Treasurer
10 Bingham Street
Middletown, Ill.

July 1, 195–

3	doz. rolls @ 24¢	\$	72
4½	lb. frankfurters @ 60¢	2	70
1	mustard		05
24	bottles soda @ 5¢	1	20
½	pk. apples @ 50¢		25
3	boxes marshmallows @ 35¢	1	05
		\$5	97

A personal account and a budget

Money Received				Money Spent			
Apr.				Apr.			
20	Cash on hand	0	00	20	Paid to Eric		35
	Washed and walked dog		50	21	Ice cream		15
					Tablet and pencil		10
	Cleaned car		50	22	Candy		20
21	Yard work		75	23	Sundae		25
24	Raked leaves	1	25	24	Game		50
25	Borrowed		15	25	Sunday school		10
				26	Gave to club	1	50
					Cash on hand		00
	Total				Total		

1. Jerry's weekly account is shown above. Does it balance?

2. Below are Jerry's earnings and spendings for the following week. Put them in the form of an account, and find out if the account balances.

RECEIVED — Apr. 27, Cash brought forward, $0.00; Apr. 27, errand, $.25; Apr. 28, painted fence, $1.00; Apr. 30, took care of Eddie, $.50; May 1, yard work, $1.25.

SPENT — Apr. 29, birthday present, $.35; Apr. 30, ice cream, $.15; May 1, model plane, $.25, game, $.50; May 2, Sunday school, $.10; May 3, trip to zoo, $1.50, candy $.05, paid debt of $.10. Cash on hand, $0.00.

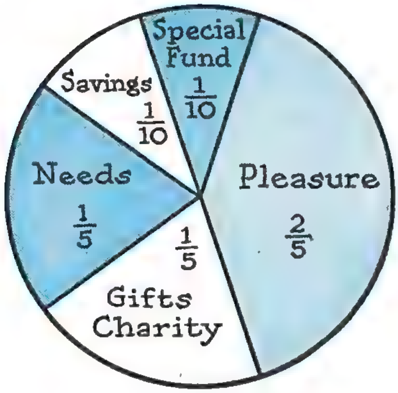
Jerry's father looked over Jerry's accounts.

"Jerry," said his father, "I thought you said you wanted to save money for a radio. I notice you haven't saved a cent these last two weeks.

"A good businessman," his father said, "plans what his money shall do for him and then he carries out his plans."

So Jerry and his father worked out a plan, shown on the next page, for spending his income. Such a plan is called a *budget*.

Jerry's Budget



3. What part of Jerry's earnings was to be spent on his own pleasure? on gifts? on savings?

What part was to be put in a special fund?

The special fund was to be put aside to spend only for something very special which Jerry's budget could not take care of otherwise.

Name some things you think Jerry might possibly plan to do with the money in his special fund.

4. If Jerry earns \$3.00 next week and turns over half to his club, how much will he have left to budget?

5. When Jerry has \$1.50 to plan on, how much should he save?

How much should he put in the special fund?

How much should he spend on his needs? on his own pleasure? on gifts or charity?

6. Find how much should go to each item when Jerry has \$2.00 to budget.

7. If you would like to make a budget for yourself, you should first keep a daily list of income and spending for several weeks. You could keep a record like the one below. Then decide on a good sensible plan for using your income.

SAMPLE PERSONAL DAILY BUDGET FOR THE STUDENT

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.	Total
Income								
Savings								
Expenses:								
Transportation								
Lunches								
Movies								
Candy, sodas, and other between-meal snacks								
Other expenses								

Arithmetic roundup

Oral review

1. $4.5 \div .3 = \underline{\ ?\ }$ asks the question, "How many .3's are there in 4.5?" The answer is $\underline{\ ?\ }$.

2. What question does each of these ask?
$4 \div \frac{1}{2} = \underline{\ ?\ }$ $\quad 6 \div .5 = \underline{\ ?\ }$

3. What is the answer to each question in Ex. 2?

4. Which is nearer to $\frac{2}{3}$ in value, .60 or .8?

5. Which is larger, .4 or .36?

6. Dividing by $\frac{1}{4}$ is the same as multiplying by $\underline{\ ?\ }$.

7. Does $12 \times \$.50 = \frac{1}{2} \times \$12$?

8. How many times as large as $\frac{1}{3}$ is 6?

9. Is 3×1.6 a little more than 4 or is it almost 5?

10. Is \$4.89 a little more than \$4 or is it almost \$5?

11. Is $6 \times \frac{2}{3}$ more or less than 6?

12. Express "4 out of 5" as a fraction.

Tell the missing numbers:

13. $\frac{1}{8}$ $\quad \frac{1}{4}$ $\quad \frac{1}{2}$ $\quad \underline{\ ?\ }$ $\quad 2$ $\quad \underline{\ ?\ }$

14. 9 $\quad$ 3 $\quad$ 1 $\quad \underline{\ ?\ }$ $\quad \frac{1}{9}$

15. .5 $\quad$ 1.5 $\quad$ 4.5 $\quad \underline{\ ?\ }$ $\quad$ 40.5

Written review

	a	*b*	*c*
1.	$89.6 + 9.4$	586×3.08	$1295.46 \div 27$
2.	$9.65 - 3.04$	60.8×25.5	$2.451 \div 43$
3.	$20.88 - 14.95$	87.8×7.25	$20.825 \div .98$
4.	$28\frac{1}{4} - 16\frac{1}{3}$	$2\frac{1}{2} \times 4\frac{1}{3}$	$5\frac{1}{2} \div 2\frac{1}{5}$

5. Divide 3179 by 89 and carry the answer to two decimal places.

6. What is the volume of a concrete block $4' \times 6' \times 2\frac{1}{2}'$?

7. The deck space on a Pan American clipper is 828 sq. ft. How much space is allowed per passenger, if the ship carries 36 passengers?

A page of review

1. Is 807 + 9,295 + 7,086 about
15,000? 20,000? 17,000?

2. Is 12,602 − 6,895 about
9,000? 4,000? 6,000?

3. Is 806 × 6,857 about
6,000,000? 8,000,000? 5,600,000?

4. Which has the largest quotient?
$29\overline{)630}$ $28\overline{)630}$ $27\overline{)630}$

5. Multiplier is 5.8; multiplicand is 79.6; product is _?_.

6. Tell the common denominator of:
- twelfths, halves, and thirds.
- fourths, halves, and fifths.

7. Find $\frac{5}{8}$ of 40; of 65; of $17\frac{1}{2}$.

8. What is $\frac{1}{2}$ of $\frac{4}{5}$? of $\frac{8}{9}$? of $\frac{3}{8}$?

9. Multiply each number by 10. Divide each number by 10.
8 14 125 .6 .25

10. Find .1 of 24; of 175; of .88.

11. Divide $\frac{1}{2}$ by $\frac{1}{8}$; by $\frac{1}{10}$; by $\frac{1}{6}$.

12. Divide 6 by $\frac{1}{2}$; by $\frac{1}{3}$; by $1\frac{1}{4}$.

13. $4 = \frac{?}{5}$ $6 = \frac{?}{6}$ $5 = \frac{?}{10}$

14. At 3 for 35¢, a dozen cans of soup will cost _?_.

15. At 2¢ an ounce, 5 lb. of candy eggs will cost _?_.

16. Does a hen egg weigh about
.2 oz. or 2 oz. or 20 oz.?

17. Is the width of an ordinary door about 2 yd. or 2 ft. or 30 in.?

18. Multiply 6,857 by 806.

19. Divide 123,310 by 295.

20. Write in words 7,008,000.

21. $6\frac{7}{12} + 10\frac{1}{2} + 8\frac{1}{3} + \frac{3}{4} =$ _?_.

22. From $18\frac{5}{8}$ subtract $9\frac{1}{2}$.

23. At $12\frac{1}{2}$¢ a foot, how much will 48 ft. of plastic hose cost?

24. 8.89+16.2+175.8+28= _?_.

25. 96.2 − 9.62 = _?_.

26. 22.88 is _?_ times .088.

27. At $1.50 a yard, how much will 24 in. of velvet cost?

28. A field 50 rd. × 16 rd. has a perimeter of _?_ rds.
It has an area of _?_ acres.

29. In an excavation 60′ × 48′ × 9′ there are _?_ cu. yd.

30. Nancy baked and sold 3 doz. cookies at 25¢ a dozen. They cost her 48¢. She made _?_¢.

31. Nancy earned 35¢ for 20 min. work. She was paid at the rate of _?_ an hour.

32. Ed gets 25¢ for 100 lb. of old newspapers. For 20 lb. he gets _?_.

33. Two girls have a quarter, 3 dimes, 3 pennies. If they share the money equally, each gets _?_¢.

For those who like to think!

You do not always have to work out a division to answer important questions about it. Study the divisions in the box. See if you can find a division in which there will be:

1. a quotient of twenty-some.
2. a quotient of less than 10.
3. a remainder in the quotient.
4. one zero in the quotient.
5. two zeros in the quotient.
6. a quotient of almost 20.
7. a three-place quotient.
8. a quotient of almost 40.

a	*b*
$35\overline{)3570}$	$15\overline{)325}$
c	*d*
$23\overline{)6900}$	$100\overline{)999}$
e	*f*
$32\overline{)639}$	$250\overline{)9750}$

In each example below a multiplication is given. Use it to help you think out the answer to the division that follows it.

In Ex. 9*a* think: $4 \times 25 = 100$; therefore $100 \div 25 = 4$.

$$\text{So } 125 \div 25 = 5 \quad \text{Why?}$$
$$126 \div 25 = 5 \text{ r}1.$$

In Ex. 10*a* think: $4 \times 25 = 100$; therefore $100 \div 25 = 4$. So $200 \div 25 =$ twice 4, or ?.

	a	*b*
9.	$4 \times 25 = 100$; so $126 \div 25 =$?	$33 \times 31 = 1023$; so $1030 \div 31 =$?
10.	$4 \times 25 = 100$; so $200 \div 25 =$?	$33 \times 31 = 1023$; so $1000 \div 31 =$?
11.	$50 \times 18 = 900$; so $936 \div 18 =$?	$4 \times 36 = 144$; so $1440 \div 36 =$?
12.	$50 \times 18 = 900$; so $882 \div 18 =$?	$4 \times 36 = 144$; so $288 \div 36 =$?
13.	$32 \times 24 = 768$; so $744 \div 24 =$?	$44 \times 50 = 2200$; so $2100 \div 50 =$?
14.	$32 \times 24 = 768$; so $792 \div 24 =$?	$44 \times 50 = 2200$; so $2190 \div 50 =$?
15.	$64 \times 25 = 1600$; so $800 \div 25 =$?	$15 \times 24 = 360$; so $390 \div 15 =$?

A savings account

Sally and Nancy Nelson have each opened a ***savings account*** at a bank. The money the bank pays them on their savings is called ***interest.***

Mr. Nelson said, "When you put money in a bank, we say you ***deposit*** money in the bank; you are called a *depositor.* Each time you take money to the bank, a ***deposit slip*** must be filled out. It shows how much money you wish to deposit."

Nancy's deposit slip looked this way after it had been filled out:

UNION TRUST COMPANY

DEPOSIT TO CREDIT OF

Nancy Nelson

SPRINGFIELD, MISS. *April 15* 19*5-*

	DOLLARS	CENTS
BILLS	3	00
COIN		45
CHECKS		
1		
2		
3		
TOTAL $	3	45

1. In what bank did Nancy open her account?

When Nancy handed the teller (the clerk) the deposit slip with the $3.45, he made out a ***deposit book,*** or ***passbook,*** for her.

This is the way the first page of the deposit book looked when the teller gave it to her.

ACCT. NO. *1104*

IN ACCT. WITH *Nancy Nelson*

	DATE	WITHDRAWAL	DEPOSIT	INTEREST	BALANCE
1	*Apr. 15, 195-*		*$3.45*		
2					
3					
4					
5					
6					

2. The teller told Nancy to be sure to bring the deposit book with her every time she came to deposit money. Why?

3. On what date did Nancy deposit the $3.45?

4. Get some deposit slips from a bank in your neighborhood. Fill one out to show that on April 22 Nancy deposited $1.85.

5. On April 29 Nancy deposited $2.37. Make out a deposit slip for $2.37.

6. On April 29 Sally had a balance of $3.89 in her savings account. She made a deposit of $1.74. What was the total amount in her savings account then?

7. On May 1 Sally (Ex. 6) withdrew $1.25 from her account. What was the balance then?

Saving and spending

1. Tony saved \$25. With the money he bought a rowboat.

He rents out the boat for 25¢ an hour, and so far he has made \$4.00. He said, "I have put my \$25 to work."

Have you ever put any money to work? If so, tell the class about it.

2. If Sally puts \$2 in her bank account each week for a year, how much will she have saved by the end of the year?

3. If Nancy saves 10¢ a day each day for a year, how much will she have saved by the end of the year?

4. Benjamin Franklin said, "A penny saved is a penny earned." What did he mean by that?

5. If Nancy puts 2¢ a day into a toy bank, what are some of the gifts she can buy for her mother at the end of a year?

6. If Lester buys a 25-cent United States Savings Stamp each week, how many weeks will it be before he has enough to buy a Series E Savings Bond for \$18.75?

Would it take Lester about a year, $1\frac{1}{2}$ years, or 2 years to save the \$18.75?

7. If Sally puts away 5¢ a day, how much will she save in a year? in 2 years?

8. It will probably be six years before Peter is ready for college.

If he saves 5¢ a day during the first year, 10¢ a day during the second year, 15¢ a day during the third year, 20¢ a day during the fourth year (a leap year), 25¢ a day during the fifth year, and 30¢ a day during the sixth year, how much will he have saved toward his college expenses?

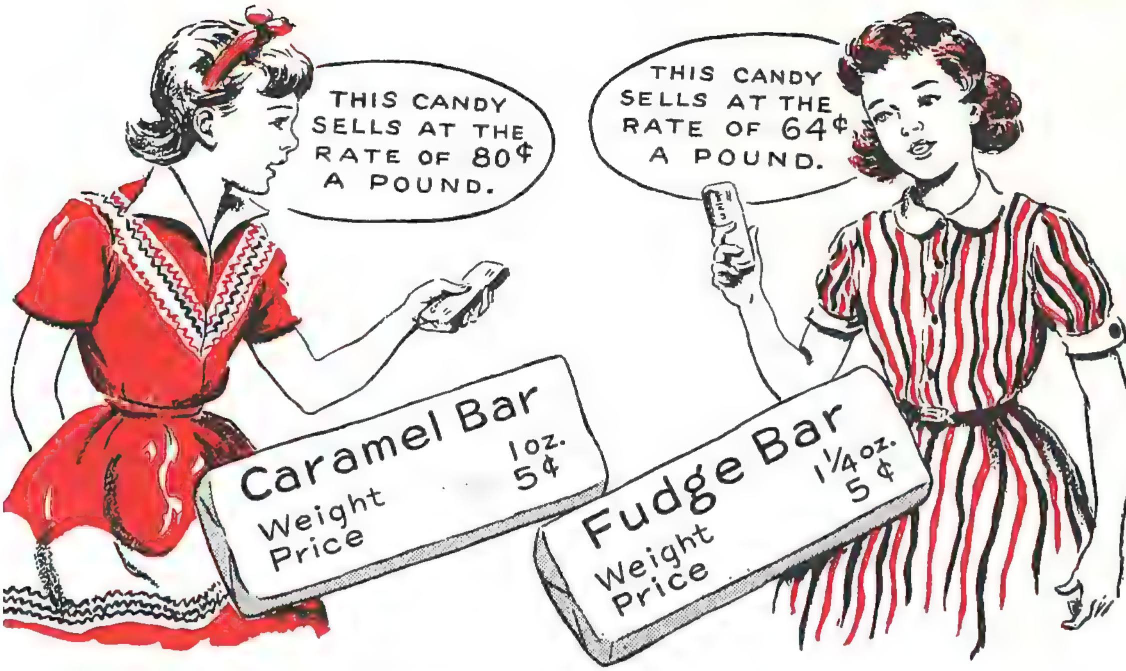
9. Most families should try to save at least $\frac{1}{10}$ of their income. At that rate what would be saved each month if the income were \$180 a month? \$250? \$275? \$350?

10. Mrs. Bright told Barbara that she wanted her to learn not only how to earn and save money, but also how to spend money.

Barbara laughed. "Everybody knows how to *spend* money," she said.

"Oh, no," said Mrs. Bright. "It is hard work to learn to spend wisely. Some persons are misers. Others waste their money."

Tell how you are learning to spend wisely the money you have earned.



1. How did Ann figure that the Caramel Bar sells at the rate of 80¢ a pound?

2. How did Dotty figure the rate per pound of the Fudge Bar?

(*Hint:* 5¢ for $1\frac{1}{4}$ oz. is how much for 1 ounce? for 16 ounces?)

3. Chocolate-covered peanuts costing 1¢ had a net weight of $\frac{3}{8}$ ounce. That is at the rate of $1¢ \div \frac{3}{8}$, or _?_¢, an ounce.

The price per pound is _?_¢.

4. A 10-cent Supreme Chocolate Nut Bar weighs 2 ounces. A 20-cent Supreme Chocolate Nut Bar weighs 5 ounces.

What is the price per pound of the chocolate in the smaller bar? in the larger bar?

Which bar is the better buy?

5. Figure the cost per pound of the following spices:

$1\frac{1}{4}$ oz. can black pepper.....	35¢
$1\frac{1}{2}$ oz. can ginger...........	19¢
$1\frac{5}{8}$ oz. can cinnamon........	12¢
2 oz. can cloves............	16¢

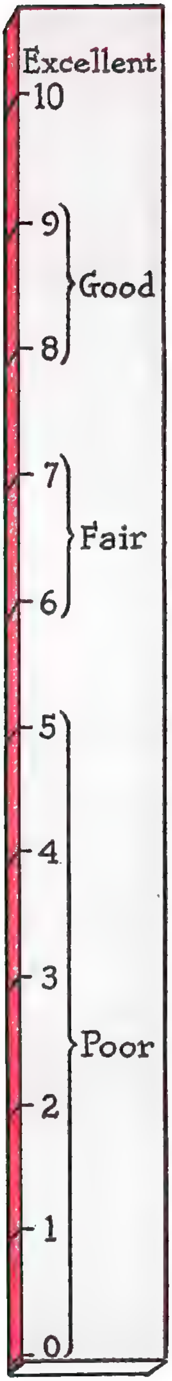
6. Tom paid 25¢ for a 5-ounce bag of potato chips. He paid at the rate of _?_¢ a pound.

7. Ted paid 10¢ for a $1\frac{3}{8}$-ounce bag of cheese-coated popcorn. He paid at the rate of _?_¢ a pound.

8. Bring some candy wrappers to school. Figure out the cost per pound of the candy.

9. Do good shoppers read the labels on packages and cans? Make a list of rules that good shoppers should follow.

Problem Test 7



Measure your growth in problem solving.

1. Philip sold 35 chickens for \$26. Find to the nearest cent the average selling price per chicken.

2. Rob did 15 examples in $7\frac{1}{2}$ minutes. At that rate, how many examples did he do in 2 minutes?

3. A scale of $\frac{1}{4}''$ to 200 miles was used on a map. How far apart are two places which measure $1\frac{1}{4}''$ apart on the map?

4. How much will the linoleum for a playroom floor $18' \times 13'$ cost at \$2.25 a square yard?

5. A bus makes 4 stops in going 16 miles. The first stretch is $3\frac{1}{8}$ miles, the second $4\frac{1}{4}$ miles, and the third $4\frac{1}{2}$ miles. How many miles long is the fourth stretch?

6. Betty bought a pound of tea in small packages, each weighing one eighth of a pound. Each package cost 10¢. How much more did Betty's tea cost than one pound of 60-cent tea?

7. An airmail pilot flew 1425.6 mi. in 12 hours. What was his average rate of speed?

8. It costs 8¢ a half ounce to send first-class mail to the Canal Zone. How much will it cost to send by first-class mail a package which weighs 18 oz.?

9. A mechanic told David that the engine he liked was a 550-horsepower engine and that it weighed 1.12 times its horsepower. David figured the engine weighed _?_ pounds.

10. Dick Carr buys magazines for 6¢ each and sells them for 10¢. How much does he make on 25 magazines?

Record your score on your Problem Test Record.

Using decimals in comparisons

(Optional)

In the Farmville School 68 out of every 100 children travel by school bus.

We can write this comparison in these two ways:

- $\dfrac{\text{No. who travel by bus}}{\text{100 children}} = \dfrac{68}{100}$
- $\dfrac{\text{No. who travel by bus}}{\text{100 children}} = .68$

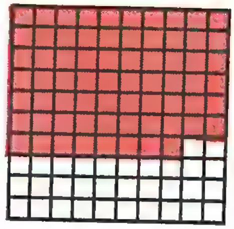
1. How many children out of every 100 in the Farmville School do not travel on the school bus?

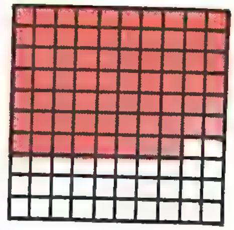
Write a common fraction and a decimal to compare the number who do not ride on the bus with every 100 children in the school.

> If 100 children come out of the Farmville School when school closes, 68 of them go home on school buses. The other 32 go home some other way.
>
> Then, if another 100 children come out, the same thing happens again. This happens over and over until every child has gone home.

2. Each large square at the top of the next column represents 100 Farmville pupils. Each small square represents _?_ child.

What do the 68 colored squares represent? the 32 white squares?





3. How many children out of 100 children go home by bus? How many children out of 200 children? How many children out of 300 children?

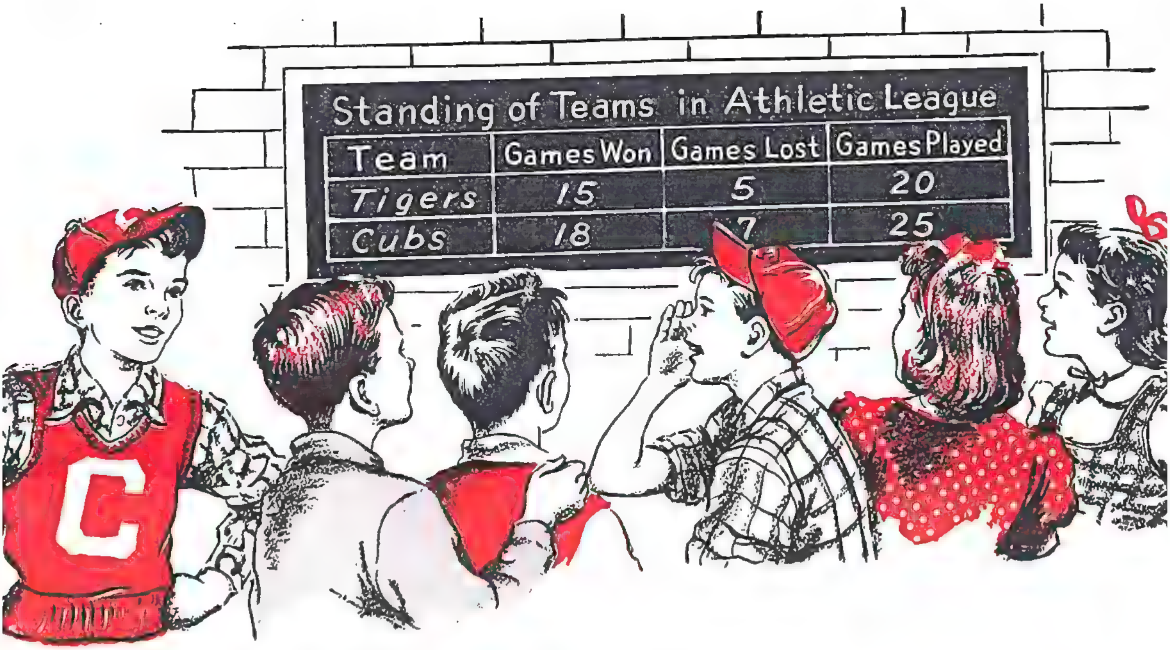
4. How many children out of 100 children do not travel by bus? How many children out of 200 children? How many children out of 300 children?

5. About .49 of the families in the Glendale School District live on farms. Does this mean that about $\frac{1}{10}$, $\frac{1}{4}$, or $\frac{1}{2}$ of the families in Glendale District live on farms?

6. Write a decimal to show what part of the families in Glendale District do not live on farms.

7. Mr. Barnes spends .26 of his wages for rent. Is that about $\frac{1}{10}$, $\frac{1}{4}$, or $\frac{1}{2}$ of his wages?

8. Write a decimal to show what part of his wages Mr. Barnes has left after he pays his rent.



Using decimals in comparisons

The Forest Grove School has an athletic league. The standings of the teams playing each day are posted on the bulletin board.

1. The record shows that the Tigers have won _?_ games and lost _?_. The Cubs have won _?_ and lost _?_.

The pupils in the sixth grade want to know which team is ahead.

To find each team's standing, they must compare the *number of games won* with the *number of games played.*

$$\text{Tigers: } \frac{\text{Games won}}{\text{Games played}} = \frac{15}{20}$$

$$\text{Cubs: } \frac{\text{Games won}}{\text{Games played}} = \frac{18}{25}$$

2. Do you know a good way to find which is larger, $\frac{15}{20}$ or $\frac{18}{25}$?

3. The pupils decided to change $\frac{15}{20}$ and $\frac{18}{25}$ to fractions having a common denominator:

$$\text{Tigers: } \frac{15}{20} = \frac{15 \times 5}{20 \times 5} = \frac{75}{100}$$

$$\text{Cubs: } \frac{18}{25} = \frac{18 \times 4}{25 \times 4} = \frac{72}{100}$$

Which team was ahead?

4. The teacher told the pupils that they could have changed the fractions to hundredths as shown below. Explain.

Do these standings of the teams agree with those in Ex. 3?

$$\text{Tigers: } \frac{15}{20} = \frac{3}{4} = 3 \div 4 = 4\overline{)3.00}\ \ (.75)$$

$$\text{Cubs: } \frac{18}{25} = 18 \div 25 = 25\overline{)18.00}\ \ (.72)$$

$$\begin{array}{r} .72 \\ 25\overline{)18.00} \\ \underline{17\,5} \\ 50 \\ \underline{50} \end{array}$$

5. If the Tigers lose tomorrow and the Cubs win, the standings of the teams will change to:

	Won	*Lost*	*Played*
Tigers:	15	6	21
Cubs:	19	7	26

For each team write a fraction to compare the number of games won with the number of games played.

These fractions can be changed to hundredths this way:

$$\text{Tigers: } \frac{15}{21} = \begin{array}{r} .71 \\ 21\overline{)15.00} \\ \underline{14\,7} \\ 30 \\ \underline{21} \\ 9 \end{array}$$

$$\text{Cubs: } \frac{19}{26} = \begin{array}{r} .73 \\ 26\overline{)19.00} \\ \underline{18\,2} \\ 80 \\ \underline{78} \\ 2 \end{array}$$

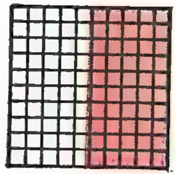
6. Which team will be ahead if the Tigers lose and the Cubs win?

Will this change the standings of the teams? (See Ex. 4.)

7. Can you make up a rule for changing a common fraction to hundredths in decimal form?

(Use Exs. 4 and 5 to check your rule.)

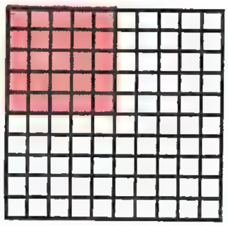
8. In this large square there are _?_ small squares. How many of the small squares are colored?



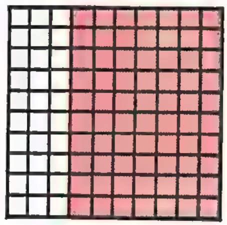
The picture shows that $\frac{1}{2}$ = _?_ hundredths. Use the rule you made in Ex. 7 to prove the same thing.

9. The colored squares in each picture below will help you find the missing number below the picture.

A



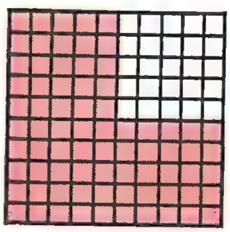
B



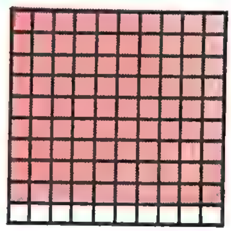
a) $\frac{1}{4}$ = _?_ hundredths

b) $\frac{7}{10}$ = _?_ hundredths

C



D



c) $\frac{3}{4}$ = _?_ hundredths

d) $\frac{9}{10}$ = _?_ hundredths

10. Use the rule you made in Ex. 7 to prove that your answers to Ex. 9 are right.

Changing common fractions to decimals

A group of boys of the science club had each planted a different variety of beans in the window trays in the science room. They were reporting on the results and telling what part of the seeds of each variety had come up. Some boys used common fractions and some used decimals, as shown in this table.

KIND OF SEED	SEEDS THAT CAME UP
Rival	$\frac{4}{5}$
Early bush	$\frac{7}{8}$
No string	.80
Tender	$\frac{3}{4}$
Pride	$\frac{5}{8}$
Supreme	.75
Long green	$\frac{2}{3}$

Peter, the group leader, said, "We cannot compare these reports unless we express them all in the same way." Peter then changed all the fractions to decimals, carried to hundredths.

- To change $\frac{4}{5}$ to a decimal, think: $\frac{4}{5}$ means $4 \div 5$ ⟶ $5\overline{)4.00}$ = .80

- To change $\frac{7}{8}$ to a decimal, think: $\frac{7}{8}$ means $7 \div 8$ ⟶ $8\overline{)7.00}$ = $.87\frac{1}{2}$

- Change $\frac{3}{4}$, $\frac{5}{8}$, and $\frac{2}{3}$ to decimals (hundredths).

Which variety of beans made the best record? the poorest?

To change a fraction to a decimal, place a decimal point and one or more zeros after the numerator and divide by the denominator.

Change to decimals:

1. $\frac{1}{3}$ $\frac{5}{8}$ $\frac{7}{8}$ $\frac{1}{10}$ $\frac{3}{10}$

2. $\frac{1}{8}$ $\frac{3}{5}$ $\frac{4}{5}$ $\frac{1}{6}$ $\frac{5}{6}$

To change $6\frac{1}{2}$ to a decimal, think: $\frac{1}{2} = .5$; so $6\frac{1}{2} = 6.5$.

Change to decimals:

3. $4\frac{1}{8}$ $4\frac{1}{5}$ $5\frac{5}{8}$ $9\frac{2}{3}$ $7\frac{7}{8}$

4. $8\frac{3}{8}$ $6\frac{4}{5}$ $4\frac{3}{5}$ $8\frac{5}{6}$ $6\frac{2}{3}$

5. Which is larger:

$\frac{3}{5}$ or .65? $\frac{5}{8}$ or .58? $\frac{2}{3}$ or .69?

6. Is 5 out of 8 a better record than 2 out of 3? Is 5 out of 8 a better record than 3 out of 5?

7. One boy missed 7 words out of 30. His teammate missed 6 words out of 25. Who made the better record?

Decimals and fractions

Change to common fractions in lowest terms:

1. .20 .40 .80 .90

2. .50 .75 .25 .35

3. 1.25 1.50 1.75 2.00

4. 3.10 3.20 3.30 3.40

Change to decimals:

5. $\frac{4}{8}$ $\frac{5}{8}$ $\frac{6}{8}$ $\frac{7}{8}$ 1

6. $\frac{1}{3}$ $\frac{2}{3}$ 1 $1\frac{1}{3}$ $1\frac{2}{3}$

7. $\frac{7}{10}$ $\frac{8}{10}$ $\frac{9}{10}$ 1 $1\frac{1}{10}$

8. $2\frac{1}{4}$ $2\frac{3}{4}$ $2\frac{1}{2}$ $\frac{3}{4}$ $3\frac{1}{4}$

Which is larger?

9. $\frac{3}{5}$ or .65 $\frac{5}{8}$ or .58

10. $\frac{2}{3}$ or .69 .85 or $\frac{7}{8}$

11. $\frac{5}{6}$ or .90 $\frac{3}{4}$ or .74

In Exs. 12–15, change the four fractions to decimals. Arrange the decimals in order, beginning with the smallest.

12. $\frac{3}{4}$ $\frac{1}{6}$ $\frac{7}{8}$ $\frac{3}{5}$

13. $\frac{2}{10}$ $\frac{1}{3}$ $\frac{2}{5}$ $\frac{1}{6}$

14. $\frac{4}{3}$ $\frac{4}{5}$ $\frac{4}{2}$ $\frac{4}{8}$

15. $\frac{1}{4}$ $\frac{5}{8}$ $\frac{1}{3}$ $\frac{1}{5}$

Change to decimals to show that:

16. $\frac{1}{4} = \frac{2}{8}$ $\frac{1}{2} = \frac{3}{6}$ $\frac{4}{10} = \frac{2}{5}$

17. $\frac{6}{8} = \frac{3}{4}$ $\frac{1}{2} = \frac{5}{10}$ $\frac{1}{2} = \frac{4}{8}$

18. Is .76 about $\frac{3}{4}$ or $\frac{1}{2}$?

19. Is .88 about $\frac{2}{5}$ or $\frac{9}{10}$?

20. Is 1.23 about $1\frac{1}{4}$ or $1\frac{1}{8}$?

21. Is .34 about $\frac{1}{3}$ or $\frac{2}{3}$?

22. Is 2.19 about $2\frac{1}{2}$ or $2\frac{1}{5}$?

23. Is .09 about $\frac{1}{10}$ or $\frac{1}{6}$?

24. Is .61 about $\frac{3}{4}$ or $\frac{3}{5}$?

25. Team A won .78 of its ball games. Team B lost .20 of its ball games.

Which team made the better record?

Tell what common fraction you could use instead of the decimal in each of these:

26. More than .50 of the boys in Miss Blake's class can swim.

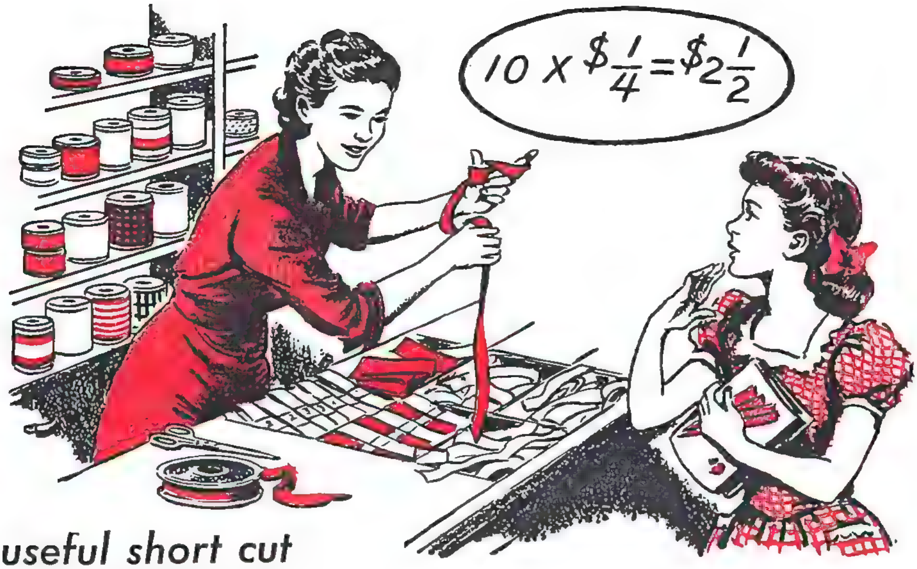
27. Less than .25 of the girls in Miss Blake's class can swim.

28. Albert did .90 of the problems correctly.

29. The Blue Team won .40 of the games it played.

30. Tom spelled correctly .75 of the words in a spelling test.

31. A pair of socks was marked .60 nylon and .40 cotton.



A useful short cut

1. Elaine was shopping for 10 yd. of ribbon at 25¢ a yard. She figured that the clerk would charge $10 \times \$.25$, or \$2.50. But the clerk said, "$10 \times \$\frac{1}{4}$ is $\$2\frac{1}{2}$."

Does $10 \times \$\frac{1}{4}$ give the same answer as $10 \times \$.25$?

2. Find the cost of 36 cups at 25¢ each. Work the problem in these two ways: →

$\begin{array}{r} \$.25 \\ \times\ 36 \\ \hline \end{array}$
$36 \times \$\frac{1}{4}$

Which way is shorter and easier? Are the answers equal?

3. Tell the cost of the following at 25¢ each; at 50¢ each. (50¢ is what part of a dollar?)

24 favors	84 stencil knives
48 toy cars	96 paintbrushes

4. $\$.05 = \frac{5}{100} = \frac{?}{20}$ dollar

5. $\$.10 = \frac{10}{100} = \frac{?}{10}$ dollar

6. $\$.20 = \frac{20}{100} = \frac{?}{5}$ dollar

7. $\$.25 = \frac{25}{100} = \frac{?}{4}$ dollar

8. $\$.50 = \frac{50}{100} = \frac{?}{2}$ dollar

9. $\$.75 = \frac{75}{100} = \frac{?}{4}$ dollar

Do not use a pencil to find these answers:

10. How much will a dozen games cost at 50¢ each?

11. How much will 2 dozen toy planes cost at 25¢ each?

12. How much will 40 knives cost at 20¢ each?

13. How much will 48 puzzles cost at 50¢ each?

14. How much will 50 books cost at 10¢ each?

15. How much will 36 fountain pens cost at 75¢ each?

Fractional parts of a dollar

$\$\frac{1}{10} = 10¢$	$\$\frac{1}{5} = 20¢$	$\$\frac{1}{8} = 12\frac{1}{2}¢$	$\$\frac{1}{6} = 16\frac{2}{3}¢$
$\$\frac{3}{10} = 30¢$	$\$\frac{2}{5} = 40¢$	$\$\frac{3}{8} = 37\frac{1}{2}¢$	$\$\frac{1}{3} = 33\frac{1}{3}¢$
$\$\frac{5}{10} = 50¢$	$\$\frac{3}{5} = 60¢$	$\$\frac{5}{8} = 62\frac{1}{2}¢$	$\$\frac{1}{2} = 50¢$
$\$\frac{7}{10} = 70¢$	$\$\frac{4}{5} = 80¢$	$\$\frac{7}{8} = 87\frac{1}{2}¢$	$\$\frac{2}{3} = 66\frac{2}{3}¢$
$\$\frac{9}{10} = 90¢$	$\$\frac{1}{4} = 25¢$	$\$\frac{3}{4} = 75¢$	$\$\frac{5}{6} = 83\frac{1}{3}¢$

This table shows the number of cents in the common fractional parts of a dollar.

1. How many cents are there in $\$\frac{3}{10}$? $\$\frac{2}{5}$? $\$\frac{3}{8}$? $\$\frac{2}{3}$? $\$\frac{5}{6}$?

2. Show how the number of cents in each fractional part of a dollar was obtained for the third and fourth columns of the table. Begin this way:

$$\$\tfrac{1}{8} = 8\overset{\$\ .12\frac{1}{2}}{\overline{)\$1.00}} = \$.12\tfrac{1}{2}$$

$$\$\tfrac{3}{8} = 8\overset{\$\ .37\frac{1}{2}}{\overline{)\$3.00}} = \$.37\tfrac{1}{2}$$

What part of a dollar is each of the following?

3. $75¢$ $\quad 16\frac{2}{3}¢$ $\quad 90¢$ $\quad 33\frac{1}{3}¢$ $\quad 80¢$

4. $66\frac{2}{3}¢$ $\quad 30¢$ $\quad 62\frac{1}{2}¢$ $\quad 20¢$ $\quad 50¢$

5. $87\frac{1}{2}¢$ $\quad 12\frac{1}{2}¢$ $\quad 60¢$ $\quad 37\frac{1}{2}¢$ $\quad 30¢$

6. Study the table at the top of the page until you can give the answers to Exs. 3–5 without help.

Find the cost of these articles by the short method you learned on page 274. Do not use a pencil.

7. 16 balls of twine at $37\frac{1}{2}¢$

8. 24 boxes of paints at $62\frac{1}{2}¢$

9. 64 jars of jelly at $12\frac{1}{2}¢$

10. 16 pencil sets at $87\frac{1}{2}¢$

11. 24 pairs of socks at 75¢

12. 36 pots of ivy at $66\frac{2}{3}¢$

13. 56 washcloths at $12\frac{1}{2}¢$

14. 72 tubes of paste at 25¢

15. Tom made up this rule: To find the cost of any number of articles at 50¢ each, find the cost at $1.00 each and then divide the answer by 2.

Show why Tom's rule works.

16. Make a rule like Tom's for finding the cost of any number of articles at 25¢ each; at 75¢; at 40¢; at $12\frac{1}{2}¢$.

Choosing the easier way

Charles

$$4\frac{3}{4} = 4\frac{3}{4}$$
$$5\frac{1}{2} = 5\frac{2}{4}$$
$$9\frac{5}{4} = 10\frac{1}{4}$$

Esther

$$4\frac{3}{4} = 4.75$$
$$5\frac{1}{2} = 5.50$$
$$10.25$$

1. Charles and Esther needed to find the sum of $4\frac{3}{4}$ and $5\frac{1}{2}$. Explain their work above. Whose way do you like better?

Esther says her way is easier. Do you agree?

Do each of these additions in two ways (using common fractions and using decimals). Then decide which way seems easier in each example.

	a	*b*
2.	$2\frac{3}{10} + 1\frac{4}{5}$	$4\frac{5}{6} + 2\frac{1}{2}$
3.	$5\frac{1}{2} + 6\frac{7}{10}$	$2\frac{6}{10} + 3\frac{1}{2}$
4.	$4\frac{3}{5} + 7\frac{1}{2}$	$1\frac{3}{4} + 2\frac{4}{5}$

Do these subtractions in two ways (using common fractions and decimals). Which way seems easier?

	a	*b*
5.	$3\frac{1}{4} - \frac{1}{2}$	$8\frac{5}{6} - 2\frac{1}{3}$
6.	$7\frac{1}{2} - 2\frac{3}{10}$	$9\frac{6}{10} - 3\frac{1}{2}$
7.	$5\frac{2}{5} - 3\frac{1}{2}$	$10\frac{3}{4} - 2\frac{4}{5}$
8.	$6\frac{1}{2} - 2\frac{4}{5}$	$4\frac{1}{3} - 1\frac{1}{4}$
9.	$8\frac{1}{4} - 1\frac{1}{2}$	$4\frac{1}{5} - 2\frac{7}{10}$

10. Which of these ways for finding $2\frac{1}{2} \times 6\frac{1}{4}$ do you think is easier? Are the answers equal?

- $2\frac{1}{2} \times 6\frac{1}{4} = \frac{5}{2} \times \frac{25}{4} = \frac{125}{8} = 15\frac{5}{8}$

- $$\begin{array}{r} 6.25 \\ \times\ 2.5 \\ \hline 3125 \\ 1250 \\ \hline 15.625 \end{array}$$

Multiply in two ways. Then decide which way seems easier.

	a	*b*
11.	$3\frac{3}{10} \times 2\frac{1}{2}$	$1\frac{5}{10} \times 2\frac{1}{5}$
12.	$4\frac{1}{5} \times 3\frac{1}{10}$	$3\frac{3}{4} \times 5$
13.	$3\frac{3}{4} \times 2\frac{1}{2}$	$8 \times 2\frac{4}{5}$

14. Which of these ways of finding $6\frac{1}{4} \div 2\frac{1}{2}$ seems easier? Are the answers equal?

- $6\frac{1}{4} \div 2\frac{1}{2} = \frac{25}{4} \div \frac{5}{2} =$

$$\frac{\overset{5}{\cancel{25}}}{\underset{2}{\cancel{4}}} \times \frac{\overset{1}{\cancel{2}}}{\underset{1}{\cancel{5}}} = \frac{5}{2} = 2\frac{1}{2}$$

- $$\begin{array}{r} 2.5 \\ 2.5\overline{)6.25} \\ 50 \\ \hline 125 \\ 125 \\ \hline \end{array}$$

Divide in two ways. Then decide which way is easier.

15. $7 \div 3.5$ $\qquad 9.25 \div .25$

Beware of extra numbers!

Sometimes numbers which are not needed are given in a problem. If you know *what you are asked to find* and *how you will find it,* the extra numbers will not bother you.

Tell which number or numbers in each problem on this page are not needed. Then solve the problem.

1. Find the cost of $3\frac{1}{2}$ yd. of 54-inch-wide velvet that sells at $3.50 a yard.

2. Find the cost of 2 pairs of sneakers, size $4\frac{1}{2}$, at $2.29 a pair.

3. How much weatherstripping is needed around the 4 edges of a door that is 7′ high, $2\frac{1}{2}$ ft. wide, and 2″ thick?

4. How much change will you get from $5.00 after buying 6 place mats, each 12″ by 18″, at $.65 each?

5. At 60¢ a pound, what will be the cost of the $1\frac{1}{4}$ lb. of nut meats needed for 3 cakes?

6. Louis raised 150 chicks. How much did he receive for 75 chicks at 75¢ each?

7. Mildred picked 48 roses. How much did she receive for 8 bunches at 15¢ a bunch?

8. How much will Esther have to pay for 4 necklaces, each 20 inches long, at 79¢ each?

9. Hummingbirds fly 500 miles across the Gulf of Mexico in one night. If they beat their wings 75 times a second when flying, how many times is that a minute?

10. A truck having a capacity of 5,000 lb. cost $2,150. How many tons can the truck carry?

11. A plane used 77 gallons of gasoline to fly 798 miles in 5 hours. What was the average number of gallons it used an hour?

12. A blue whale 95′ long and 39′ around weighed 147 tons. How many pounds did it weigh?

13. Dan bought 30 bunches of onions for 75¢ and sold them for $1.60. How much did he make?

14. Fred needs burlap to make a bulletin board 18″ × 24″. How much will $\frac{1}{2}$ yard of 50-inch burlap cost at 90¢ a yard?

15. Frank paid $1.00 for $\frac{1}{4}$ lb. of petunia seeds. From the seed he raised about 350 plants. He sold 23 dozen of them for 25¢ a dozen. How much money did he make?

Review practice

Add and check:

1.	a	b	c	d	e
	5	28	286	$ 3.64	$647.19
	8	36	976	17.85	89.35
	3	74	867	9.08	500.88
	9	55	504	.76	146.07
	4	66	783	6.49	25.76
	6	37	689	89.79	286.17

Subtract and check:

2.	892	780	500	1580	$25.00
	– 84	– 576	– 476	– 1098	– 2.95
3.	605	5000	$60.60	$510.00	$600.50
	– 589	– 3560	– 14.90	– 250.86	– 580.50

Multiply and check by going over your work:

4.	598	605	876	709	465
	× 705	× 504	× 67	× 60	× 800
5.	$.79	$.68	$18.98	$6.08	$16.85
	× 65	× 250	× 75	× 84	× 600

Divide and check:

6. 3016 ÷ 8
7. 285475 ÷ 95
8. 14145 ÷ 15
9. 46187 ÷ 53
10. 27004 ÷ 78
11. 4354 ÷ 86
12. 9000 ÷ 87
13. 50714 ÷ 59
14. 6784 ÷ 185
15. 7300 ÷ 89
16. 4692 ÷ 68
17. 2795 ÷ 46
18. 4056 ÷ 125
19. 8754 ÷ 28
20. 50746 ÷ 68
21. 2778 ÷ 58
22. $14.43 ÷ 39
23. $17.89 ÷ 47
24. $39.63 ÷ 38
25. $155.67 ÷ 36
26. $354.00 ÷ 45

Mental arithmetic

1. Which of these ways of mentally adding 255 and 34 do you prefer? Explain each.

- $255 + 30 = 285;\ 285 + 4 = 289$
- $250 + 30 = 280;\ 5 + 4 = 9;$
  $280 + 9 = 289$
- $255 + 35 = 290;\ 290 - 1 = 289$

Do these additions mentally. Use the method you prefer.

2.	$247 + 32$	$247 + 43$
3.	$586 + 13$	$586 + 27$
4.	$756 + 19$	$756 + 37$
5.	$354 + 212$	$478 + 207$
6.	$517 + 208$	$678 + 110$

7. Which of these ways of mentally subtracting 42 from 91 do you prefer? Explain each.

- $91 - 40 = 51;\ 51 - 2 = 49$
- $91 - 2 = 89;\ 89 - 40 = 49$
- $91 - 41 = 50;\ 50 - 1 = 49$
- $90 - 40 = 50;\ 90 - 42 = 48;$
  $91 - 42 = 49$

Do these subtractions mentally:

8.	$91 - 27$	$93 - 45$
9.	$172 - 29$	$181 - 63$
10.	$256 - 127$	$263 - 244$
11.	$385 - 192$	$781 - 392$
12.	$1000 - 305$	$1000 - 423$
13.	$1000 - 762$	$1000 - 817$

14. Which of these ways of finding 9×28 mentally do you prefer? Explain each.

- $9 \times 20 = 180;\ 9 \times 8 = 72;$
  $180 + 72 = 252$
- $10 \times 28 = 280;\ 280 - 28 = 252$
- $9 \times 8 = 72;\ 9 \times 20 = 180;$
  $72 + 180 = 252$
- $9 \times 30 = 270;\ 9 \times 2 = 18;$
  $270 - 18 = 252$

Do these multiplications mentally. Use the method you prefer.

15.	9×37	6×78	8×46
16.	7×59	6×89	8×79
17.	9×87	8×97	9×79

18. Which of these ways of finding $375 \div 25$ mentally do you prefer? Explain each.

- $100 \div 25 = 4$
  $300 \div 25 = 3 \times 4 = 12$
  $75 \div 25 = 3$
  $375 \div 25 = 12 + 3 = 15$
- $10 \times 25 = 250$
  $4 \times 25 = 100$
  $1 \times 25 = 25$
  375 contains $(10 + 4 + 1)$ 25's
  $375 \div 25 = 15.$

Do these divisions mentally:

19.	$550 \div 50$	$225 \div 25$
20.	$640 \div 20$	$960 \div 40$
21.	$450 \div 25$	$1320 \div 60$

UNIT 35

Ratios used in recipes and in enlarging pictures
Problem solving

(Optional)

Using a recipe

A recipe for Party Punch in Janet's cookbook is as follows:

3 parts fruit juice   2 parts water
1 part sugar

1. If Janet uses 3 cups of fruit juice, how much water must she use? how much sugar?

2. If she uses 3 pints of fruit juice, how much water must she use? how much sugar?

3. If she uses 1 quart of sugar, how much water must she use? how much fruit juice?

4. If she uses 2 cups of sugar, how much water must she use? how much fruit juice?

5. How much water and how much fruit juice must she use with 3 cups of sugar? 4 cups? 5? 6?

6. She must always use _?_ times as much water as sugar, and _?_ times as much fruit juice as sugar.

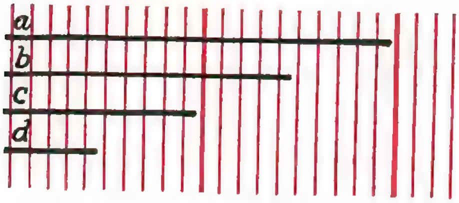
7. How much water and how much sugar must she use with 6 cups of fruit juice? 9 cups? 12 cups? 15? 21? 27? 30?

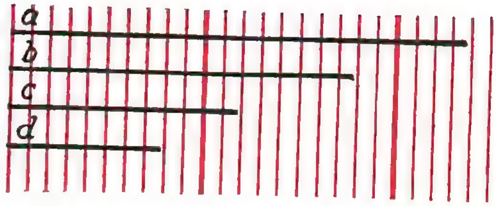
8. She must always use one _?_ as much sugar as fruit juice and _?_ thirds as much water as fruit juice.

9. How much sugar and how much fruit juice must she use with 2 cups of water? 4 cups? 6 cups? 8? 10? 3? 5?

10. She must always use one _?_ as much sugar as water and _?_ times as much fruit juice as water.

Comparing lengths





1. Line a above was drawn to be two inches long.

Use your ruler to check the length.

2. In the drawing above, the paper is ruled to tenths of an inch. How can you tell that?

3. Line b is _?_ inches long.

4. Find the length of line c; of line d.

With which of the statements in Exs. 5–11 do you agree?

5. The length of a is 4 times the length of d.

6. The length of d is $\frac{1}{4}$ the length of a.

7. The length of c is 2 times the length of a.

8. The length of c is $\frac{1}{2}$ the length of a.

9. The length of b is 3 times the length of d.

10. c is $\frac{2}{3}$ of b.

11. b is $\frac{3}{2}$ of c.

12. In the drawing above, line a is 2.4 inches. Is its length 2 whole inches + .4 of an inch?

13. Tell from the drawing the length of line b; line c; line d.

With which of the statements in Exs. 14–21 do you agree?

14. The length of c is $\frac{1}{2}$ of the length of a.

15. The length of a is 2 times the length of c.

16. When you compare the length of d with the length of a, you see that d is $\frac{1}{4}$ of a.

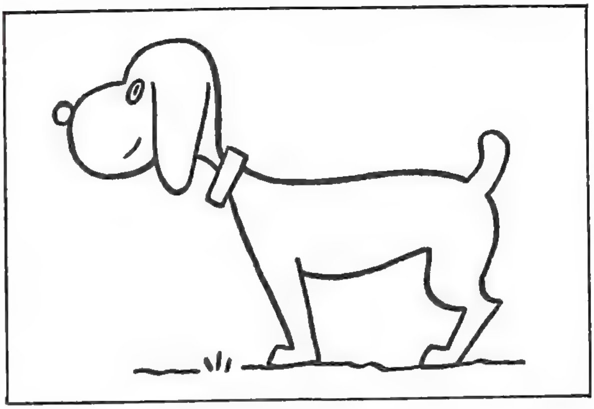
17. When you compare the length of a with the length of d, you see that $d = 4$ times a.

18. When you compare the length of d with the length of c, you see that d is $\frac{2}{3}$ of c.

19. b is $\frac{2}{3}$ of a. **20.** a is $\frac{3}{2}$ of b.

21. What fraction compares c with b? d with c? b with a?

Enlarging a picture



Ted found a small picture of a dog in a magazine. He wanted to make a large picture like it to hang on his wall.

Ted measured the picture. It was 2 in. wide and 3 in. long.

If he enlarges the picture to be twice as wide as the original picture, he must also enlarge it to be twice as long.

1. If he makes the enlargement three times as wide as the original picture, he must also make it _?_ times as long.

2. Ted's drawing paper is $11'' \times 8\frac{1}{2}''$. If he enlarges the picture to be twice as long and twice as wide as the original picture, will it fit on his paper?

3. If Ted enlarges the picture to be three times as long and three times as wide as the original picture, will his enlarged picture fit on his paper?

4. Tell what the dimensions of the enlarged picture would be if Ted makes those dimensions 4 times as large as the dimensions of the original picture.

Would this enlargement fit on his drawing paper?

5. Ted decided to make the enlarged drawing twice as long and twice as wide as the original; so he drew on drawing paper a rectangle 4 in. wide and 6 in. long.

He thought, "The width of the picture in the magazine is $\frac{2}{3}$ of its length. (2 is $\frac{2}{3}$ of 3.)

"The width of my enlargement is $\frac{4}{6}$, or _?_, of its length. My drawing must be right."

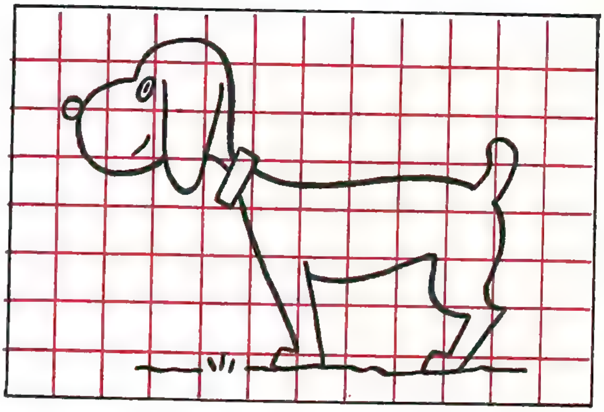
6. Is the length of the original $1\frac{1}{2}$ times the width of the original? Is the length of Ted's enlargement $1\frac{1}{2}$ times its width?

7. Tell what the dimensions of the enlarged picture would be if Ted should make them 5 times as large as the original dimensions.

Would the width of the enlargement be $\frac{2}{3}$ of the length? Would the length of the enlargement be $1\frac{1}{2}$ times the width?

8. To make his copy of the picture, Ted drew $\frac{1}{4}$-inch squares on the small picture and $\frac{1}{2}$-inch squares on the $4'' \times 6''$ rectangle on his drawing paper.

Then he copied the picture with the help of the squares. How did the squares help him to draw the picture?



Why did he make the squares on the original picture $\frac{1}{4}$ inch on each side, and the squares on the enlargement $\frac{1}{2}$ inch on each side?

After Ted had finished the enlargement, he erased the squares.

9. Ted said that by making each dimension of the picture twice as great, he made the area four times as great. Show that he was right.

10. Have you ever enlarged a picture or a map the way Ted enlarged his dog picture? Try it.

- Cut a simple drawing or cartoon from a newspaper or magazine. It should be a rectangle.
- Draw $\frac{1}{4}$-inch squares on it.
- Measure the dimensions of your rectangular cutout.
- Draw a rectangle with dimensions twice those of your cutout.
- Draw $\frac{1}{2}$-inch squares on it.
- Now you are ready to copy the drawing.

11. Many pupils make enlarged drawings of maps and pictures on the blackboards in their classrooms or on sheets of wrapping paper.

Making the dimensions of a map 6 times as great as the original dimensions makes the area of the enlarged map _?_ times as great.

12. John wants to enlarge a 4″ by 5″ picture to 4 times as large as the dimensions of the original. What will be the dimensions of his enlargement?

13. John draws $\frac{1}{4}$-inch squares on his picture. What size squares should he draw on his enlargement?

14. Did you ever take a picture and then like it so well you had it enlarged? If so, bring the snapshot and the enlargement to school for the class to see.

The dimensions of the enlargement are _?_ times the dimensions of the snapshot.

Air-age problems

It costs \$4.80 to send 5 pounds by air express from coast to coast. At this rate, how much does it cost to send 20 pounds?

You can solve this problem in two ways:

① Find the cost of sending 1 pound, and then multiply by 20.

② Find that 20 lb. is 4 × 5 lb.; then multiply \$4.80 by 4.

FIRST SOLUTION

\$4.80 ÷ 5 = \$.96 (**Cost of 1 lb.**)
20 × \$.96 = \$19.20

SECOND SOLUTION

20 ÷ 5 = 4
4 × \$4.80 = \$19.20

Which way of solving the problem is easier?

Use the second method to solve Exs. 1–4.

1. If the rate for sending 25 pounds by air express is \$24, find the cost of sending 100 pounds; 200 pounds; 50 pounds.

2. Flowers are shipped by air from Spokane to Duluth at a cost of \$33.60 per 100 pounds.

At that rate, find the cost of shipping 50 pounds; 25 pounds; 10 pounds; 5 pounds.

3. One airline uses the following items in preparing a meal for 30 persons:

2 45-oz. cans tomato soup
14 tins hamburgers
6 cans string beans
1 gal. shoestring potatoes
2 cans cherries
1 can evaporated milk
100 individual pkgs. of sugar
3 packages of Melba toast

Find the amount of each item needed for 15 persons.

4. In 1872 it took 80 days to go around the world. Now it takes about 3 days.

Is travel now about 10 times, 25 times, or 100 times as fast as it was in 1872?

5. Read the table showing flying times between cities.

Is the rate of flying between each pair of cities about the same?

FROM	TO	MILES	HOURS
New York	Berlin	3960	20
Chicago	Singapore	9365	47
New York	Capetown	7801	39
San Francisco	Brisbane	7900	39
London	Rome	887	$4\frac{1}{2}$
New York	London	3460	17
London	Berlin	574	3

Pottery for the fair

The Columbia Street School held a fair to earn money for play equipment. Miss Baldwin's class made pieces of pottery to sell.

The class bought 250 lb. of clay at 5¢ a pound, and ten dollars' worth of glaze.

After the pupils had finished modeling, they paid Mr. Glenn $13.50 to bake their pieces of pottery in his kiln.

When Mr. Glenn brought their pottery back, they had 60 pieces that were good enough to sell.

1. Find the average cost of the pieces of pottery. (Save your answer.)

2. The class set 70¢ as the average selling price of their pottery.

Do you think they intended to sell each piece of pottery for 70¢?

Why would that not have been a fair way to set the price?

3. Can you think of a fair way to set the price on each piece, so that the average will be 70¢?

Sally said, "This horse is the best piece, and this dog is the worst. Let's charge $1.25 for the horse and only $.15 for the dog."

Is the average of those two prices 70¢?

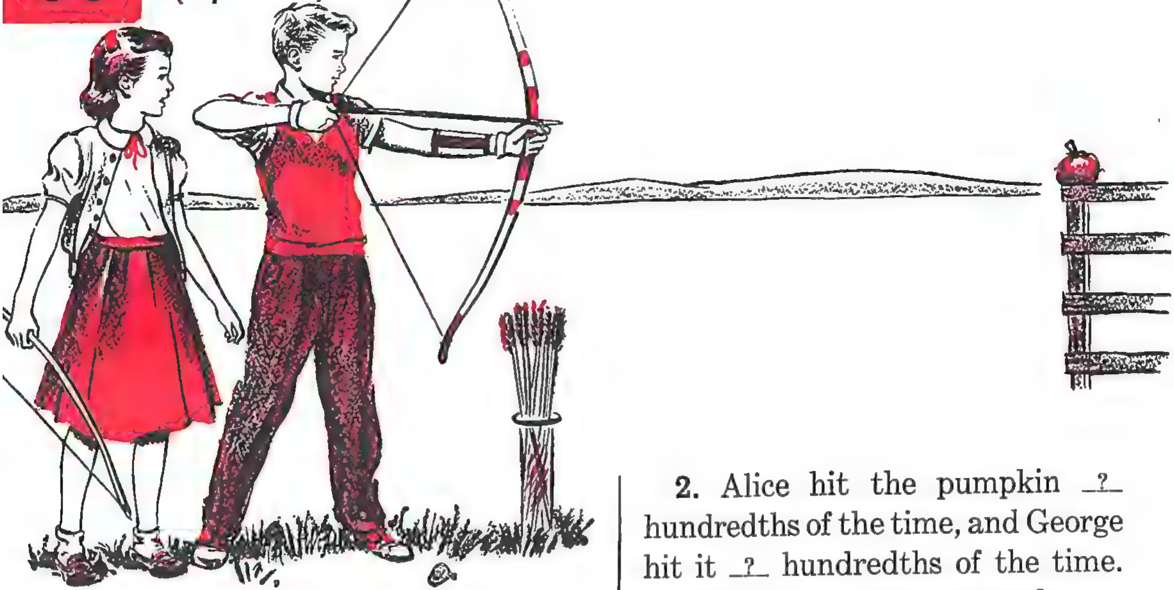
Look at the prices of the elephant and the goat in the picture. Is the average price 70¢?

Could you go on from there in setting the other prices?

4. How much did the pupils gain if they sold all 60 pieces at an average price of 70¢? Use your answer to Ex. 1.

UNIT 36

Meaning of per cent
Using per cents to make comparisons
(Optional)



Comparing scores

George and Alice were seeing who could make the best score in hitting a pumpkin on a post.

- George hit with 4 out of 5 arrows. He hit $\frac{4}{5}$ of the time.
- Alice hit with 3 out of 4 arrows. She hit $\frac{3}{4}$ of the time.

1. Who made the better score?

To compare their scores they changed both scores to hundredths. Alice did it this way:

ALICE'S SCORE

$$\frac{3}{4}=\frac{3\times 25}{4\times 25}=\frac{75}{100}$$

GEORGE'S SCORE

$$\frac{4}{5}=\frac{4\times 20}{5\times 20}=\frac{80}{100}$$

George did it this way:

ALICE'S SCORE

$$\frac{3}{4}=3\div 4=\begin{array}{r}.75\\4\overline{)3.00}\end{array}$$

GEORGE'S SCORE

$$\frac{4}{5}=4\div 5=\begin{array}{r}.80\\5\overline{)4.00}\end{array}$$

2. Alice hit the pumpkin _?_ hundredths of the time, and George hit it _?_ hundredths of the time.

Who had the better score?

You have used the following rule:

> **To find which of two fractions is larger, express them both as hundredths; then compare.**

Compare the fractions:

	a	*b*	*c*	*d*
3.	$\frac{1}{2}, \frac{1}{5}$	$\frac{1}{4}, \frac{1}{5}$	$\frac{7}{10}, \frac{3}{5}$	$\frac{3}{4}, \frac{4}{5}$
4.	$\frac{19}{28}, \frac{48}{50}$	$\frac{1}{2}, \frac{24}{50}$	$\frac{3}{4}, \frac{74}{100}$	$\frac{3}{5}, \frac{17}{25}$

5. Jane hit the bull's-eye 37 times in 50 shots. Ann hit it 17 times in 20 shots.

Which girl made the better score?

6. On Monday, David hit the bull's-eye 19 times in 25 tries. On Tuesday, he hit it 8 times in 10 tries. Compare his scores.

To the Teacher: See Note 8 on page 310.

Per cents

1. George spelled 95 out of 100 words correctly. He said, "I made a score of 95 *per cent.*"

George knew that 95 out of 100 or $\frac{95}{100}$ is 95 per cent.

Per cent means *per hundred* or *hundredths.* The symbol for per cent is %.

If George had spelled 98 of the 100 words correctly, his score would have been $\underline{?}$ per cent.

Tell how to complete the following:

2. 90 out of 100 or $\frac{90}{100} = \underline{?}\%$

3. 85 out of 100 or $\frac{85}{100} = \underline{?}\%$

4. 50 out of 100 or $\frac{50}{100} = \underline{?}\%$

5. 25% means 25 out of $\underline{?}$

6. 98% means $\frac{?}{100}$

7. 99 out of 100 or $\frac{99}{100} = \underline{?}\%$

8. 100 out of 100 or $\frac{100}{100} = \underline{?}\%$

9. $60\% = \underline{?}$ out of $\underline{?}$, or $\frac{?}{100}$

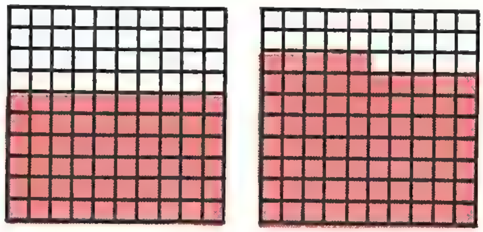
10. $20\% = \underline{?}$ out of $\underline{?}$, or $\frac{?}{100}$.

11. George said that 10% is $\frac{10}{100}$ or $\frac{1}{10}$. Do you agree?

12. In the sixth grade of one school there are 51 boys and 49 girls. What per cent of the pupils are boys? What per cent are girls?

13. How many small squares are there in Square A? How many are red? What per cent of the small squares are red? What per cent are not red?

A B



14. What per cent of the small squares in Square B are red?

15. What per cent of the small squares in Square B are not red?

16. Does $.25 = \frac{25}{100} = 25\%$?

17. A cent is what fractional part of a dollar? what per cent of a dollar?

18. Does $\$.01 = \$\frac{1}{100} = 1\%$ of $1?

19. A saving of 3 cents on the dollar is a saving of $\underline{?}\%$.

Tell how to complete the following:

	a	*b*
20.	$.25 = \underline{?}\%$	$8\% = \frac{?}{100}$
21.	$35\% = \frac{?}{100}$	$.40 = \underline{?}\%$
22.	$2\% = \frac{?}{100}$	$.06 = \underline{?}\%$
23.	$.50 = \underline{?}\%$	$.75 = \underline{?}\%$

Working with per cents

Bill took a test on 50 division facts. He did 45 of the 50 examples correctly.

Miss Gardner said, "That gives you a score of 90 per cent, Bill."

Bill said, "I thought to get 90 per cent I had to have 90 out of 100 examples correct. I did not do 100 examples. I did only 50 examples."

Miss Gardner answered, "A score of 45 correct answers out of 50 answers is the same as 90 correct answers out of 100 answers."

Miss Gardner wrote down:

$$\frac{45}{50} = \frac{45 \times 2}{50 \times 2} = \frac{90}{100} = 90\%$$

45 is 90% of 50.

1. Ann had 40 out of 50 examples correct. That is the same as _?_ examples out of 100 examples.

What per cent of the 50 examples did Ann have correct?

$$\frac{40}{50} = \frac{80}{100} = \underline{?}\%.$$

2. Ted had 42 out of 50 examples correct. That is the same as _?_ out of 100 examples.

What per cent of the 50 examples did Ted have correct?

$$\frac{42}{50} = \frac{?}{100} = \underline{?}\%.$$

3. 32 out of 50 examples is the same as _?_ out of 100 examples.

4. Tommy did 23 out of 25 examples correctly. What per cent of the examples did he do correctly?

$$\frac{23}{25} = \frac{?}{100} = \underline{?}\%.$$

5. Tell what per cent of 25 examples each of the following did correctly?

	NUMBER RIGHT		NUMBER RIGHT
Jenny	19	Julia	22
Esther	24	Oscar	14
Peter	16	Sam	25

Tell what marks you would expect on test papers on which you had done the following numbers of examples correctly:

6. 30 out of 50 $= \frac{30}{50} = \frac{?}{100} = \underline{?}\%$

7. 15 out of 50 $= \frac{15}{50} = \frac{?}{100} = \underline{?}\%$

8. 13 out of 25 $= \frac{?}{?} = \frac{?}{100} = \underline{?}\%$

9. 17 out of 25 $= \frac{?}{?} = \frac{?}{100} = \underline{?}\%$

10. 6 out of 20 $= \frac{?}{?} = \frac{?}{100} = \underline{?}\%$

11. 7 out of 20 $= \frac{?}{?} = \frac{?}{100} = \underline{?}\%$

12. 7 out of 10 $= \frac{?}{?} = \frac{?}{100} = \underline{?}\%$

13. 3 out of 10 $= \frac{?}{?} = \frac{?}{100} = \underline{?}\%$

14. 4 out of 5 $= \frac{?}{?} = \frac{?}{100} = \underline{?}\%$

15. 8 out of 10 $= \frac{?}{?} = \frac{?}{100} = \underline{?}\%$

16. 3 out of 5 $= \frac{?}{?} = \frac{?}{100} = \underline{?}\%$

Standing in the Softball League

Team	Played	Won	Lost	% of Games Won
Spitfires	8	6	2	75
Tigers	8	3	5	$37\frac{1}{2}$
Hawks	9	6	3	$66\frac{2}{3}$

1. In the scoreboard picture you see that the Spitfires won _?_ of the _?_ games played.

Does 6 out of 8 equal 75%? Check it this way:

$$6 \text{ out of } 8 = \frac{6}{8} = 8\overset{.75}{\overline{)6.00}} = 75\%$$

2. Can you show that the Tigers won $37\frac{1}{2}\%$ of their games?

$$3 \text{ out of } 8 = \frac{3}{8} = 8\overset{.37\frac{1}{2}}{\overline{)3.00}} = 37\tfrac{1}{2}\%$$

3. The Hawks won _?_ out of the _?_ games played. Does 6 out of 9 equal $66\frac{2}{3}\%$?

$$6 \text{ out of } 9 = \frac{6}{9} = 9\overset{.66\frac{2}{3}}{\overline{)6.00}} = 66\tfrac{2}{3}\%$$

4. The Rangers won 7 of the 8 games played. What per cent of the games played did the Rangers win?

$$7 \text{ out of } 8 = \frac{7}{8} = 8\overset{.??}{\overline{)7.00}} = \underline{\ ?\ }\%$$

5. In Exs. 1–4 you were finding what per cent one number is of another. Make a rule for doing this kind of problem.

6. The Bobcats won 4 of 5 games played. What per cent of their games did the Bobcats win?

7. Tom had 22 white marbles and 18 blue ones. How many marbles had he in all? What per cent of his marbles were white?

$$22 \text{ out of } 40 = \frac{22}{40} = 40\overset{.??}{\overline{)22.00}} = \underline{\ ?\ }\%$$

8. In Ex. 7, can you think of two ways to find what per cent of Tom's marbles were blue?

9. Dorothy's weather record showed that there were 24 sunny days in November. What per cent of the days were sunny?

10. Joe said that a foot is $33\frac{1}{3}\%$ of a yard. Was he right?

11. A pint is _?_% of a quart.

12. A quart is _?_% of a gallon.

13. A cup is _?_% of a quart.

14. In a basketball game Betsy made 14 baskets out of 20 shots. She had a score of _?_%.

UNIT 37

Finding a per cent of a number

(Optional)

A per cent of a number

1. Joe was ordering some strawberry plants by mail. The advertisement read, "At least 80% are guaranteed to grow."

Joe thought, "If I set out 300 plants, how many are guaranteed to grow?" Can you tell?

2. Joe reasoned: "80% is $\frac{80}{100}$. So $\frac{80}{100}$ of the 300 plants should grow. $\frac{1}{100}$ of 300 plants is _?_ plants; so $\frac{80}{100}$ of 300 plants is $80 \times$ _?_ plants, or _?_ plants."

3. Joe thought, "If I am very careful with my plants, I might be able to get about 90% of them to grow. 90% of 300 plants is $\frac{90}{100}$ of 300 plants, or _?_ plants."

Use Joe's method to find:

	a	*b*
4.	60% of 200	70% of 300
5.	80% of 500	90% of 400
6.	50% of 260	60% of 350
7.	25% of 280	35% of 700
8.	45% of 900	55% of 220
9.	65% of 200	85% of 340
10.	95% of 360	65% of 240

11. Pat found 80% of 300 this way: →

$$\begin{array}{r} 300 \\ \times .80 \\ \hline 240.00 \end{array}$$

She changed the per cent to a decimal, and multiplied. How would Pat do Exs. 4–10?

12. Which of these ways of finding 45% of 900 do you prefer?

- Change the 45% to the common fraction $\frac{45}{100}$. Then find $\frac{45}{100}$ of 900:

$$\frac{45}{\underset{1}{\cancel{100}}} \text{ of } \overset{9}{\cancel{900}} = 405$$

- Change the 45% to the decimal .45, and multiply as shown. →

$$\begin{array}{r} 900 \\ .45 \\ \hline 4500 \\ 3600 \\ \hline 405.00 \end{array}$$

13. Which of these methods of finding 23% of 400 is easier?

- 23% of $400 = \frac{23}{\underset{1}{\cancel{100}}}$ of $\overset{4}{\cancel{400}} =$ _?_
- 23% of $400 = .23 \times 400 =$ _?_

14. Which of these methods of finding 17% of 231 is easier?

- $\frac{17}{100}$ of $231 = \frac{17 \times 231}{100} = \frac{3927}{100} =$ _?_
- 17% of $231 = .17 \times 231 =$ _?_

15. In Ex. 2, how did Joe find a per cent of a number? He changed the per cent to a _?_, and found the fractional part of the number.

16. In Ex. 11, how did Pat find a per cent of a number? She changed the per cent to a _?_, and multiplied the number by the _?_.

Per cent of means **hundredths times**

To the Teacher: See Note 8 on page 310.

We Like Sports		
SPORT	FIFTH GRADE	SIXTH GRADE
Baseball	75%	76%
Swimming	90%	92%
Bicycling	55%	60%
Skating	100%	96%
Hiking	45%	52%
Tennis	35%	50%

Finding a per cent of a number

1. The Athletic Committee of the Taft School presented the table above to the Student Council. The table shows that baseball was played by _?_% of the fifth-grade pupils, and by _?_% of the sixth-grade pupils.

2. Which sport was most popular in fifth grade? in sixth grade?

3. Of the 20 fifth-grade pupils, how many liked skating?

4. What per cent of the fifth grade played baseball?

5. How many of the 20 fifth-grade pupils played baseball?

75% of 20 equals:

$\frac{75}{100}$ of 20 = .75 × 20 = _?_.

6. What per cent of the fifth grade took swimming?

7. How many of the 20 fifth-grade pupils took swimming?

90% of 20 equals:

$\frac{90}{100}$ of 20 = .90 × 20 = _?_.

8. How many of the 20 fifth-grade pupils liked bicycling?

55% of 20 = .55 × 20 = _?_.

9. How many of the fifth-grade pupils went hiking? played tennis?

10. What per cent of the sixth-grade pupils played baseball?

11. How many of the 25 sixth-grade pupils played baseball?

76% of 25 equals:

$\frac{76}{100}$ of 25 = .76 × 25 = _?_.

12. How many of the 25 sixth-grade pupils went hiking?

52% of 25 = .52 × 25 = _?_.

13. Make a rule for finding a per cent of a number.

14. 24% of 60 = .24 × 60 = _?_.

15. 35% of 80 = .35 × 80 = _?_.

To find a per cent of a number, change the per cent to a decimal and multiply.

Finding a per cent of a number

	PER CENT		COMMON FRACTION		DECIMAL FRACTION
1.	75%	=	$\frac{75}{100}$	=	.75
2.	50%	=	$\frac{?}{100}$	=	?
3.	25%	=	$\frac{?}{100}$	=	?
4.	17%	=	$\frac{?}{100}$	=	?
5.	95%	=	$\frac{?}{100}$	=	?
6.	1%	=	$\frac{?}{100}$	=	.01
7.	5%	=	$\frac{?}{100}$	=	?
8.	8%	=	$\frac{?}{100}$	=	?
9.	28%	=	$\frac{?}{100}$	=	?
10.	54%	=	$\frac{?}{100}$	=	?

11. To find 20% of 30, think: 20% = 20 hundredths; .20 of 30 = .20 × 30 = ?.

12. To find 25% of 16, think: 25% = 25 hundredths; .25 of 16 = .25 × 16 = ?.

13. To find 35% of 84, think: 35% = 35 hundredths; .35 of 84 = .35 × 84 = ?.

14. To find 15% of 40, think: 15% = 15 hundredths; .15 of 40 = .15 × 40 = ?.

15. To find 18% of 50, think: 18% = 18 hundredths; .18 of 50 = .18 × 50 = ?.

Find:

16. 60% of 85 **22.** 2% of 180

17. 14% of 15 **23.** 1% of 500

18. 84% of 75 **24.** 12% of 145

19. 56% of 45 **25.** 8% of 45

20. 5% of 300 **26.** 100% of 75

21. 6% of 250 **27.** 35% of 60

28. There are 40 children in Miss Kay's room. 50% of them are boys. How many boys are there? How many girls?

29. 70% of the 40 pupils in Miss Kay's room have not been tardy this year. How many pupils have not been tardy?

30. In Harry's Scout troop 75% of the 20 boys went to camp. How many boys went to camp?

31. Tom set out a dozen tomato plants. He said 25% of them died. How many of the plants died?

32. What per cent of Tom's plants (Ex. 31) lived? How many of his plants lived?

33. The school nurse said that 12% of the 200 pupils in Winchester school wear glasses. How many of the pupils wear glasses?

Per cents in your reading

Hunt through your newspaper this evening for places where per cents are mentioned. Read the articles or advertisements carefully to see if you understand them. If possible, bring them to school.

1. Allen read that 90% of the pupils in the Palmerton Schools belong to the Junior Red Cross.

Does that mean that nearly all, or just a few, of the pupils belong to the Junior Red Cross?

2. Diana saw a report which said that 45% of the families in Green Valley have television sets.

Do half the families in Green Valley have television sets?

3. Jack sprayed the barn with a fly-killing fluid that was 5% D.D.T. Was most of the fluid D.D.T., or just a little of it?

Do you understand the use of per cents in Exs. 4–13?

4. Bill read in his science book: "Air is 100 per cent humid when it contains all the water vapor it can possibly hold.

"Its humidity is 50% when it contains only half of all the water it can hold.

"For greatest comfort, humidity from 30% to 60% is desirable."

5. John read, "These bathing suits are guaranteed to be 100% wool."

6. Alice read, "These color-fast sweaters are 10% wool, 35% rayon, and 55% cotton."

7. "This alloy is 72% silver and 18% copper," read Jim.

8. "Pine Ranch lost 25% of its sheep in the flood," read Mary.

9. "The Canadian government taxes air travelers 10% of the cost of their tickets," reported Evelyn.

10. Alec read, "In planning an airplane, the builders follow the rule of making the fin area 12% of the wing area."

11. "The workers received an increase of 15¢ an hour, which amounts to a 10% increase in wages," reported Bill.

12. Lena read, "Argentina supplies more than 50% of the hides imported into the United States."

13. "The land area of New Zealand is only 3% of that of Australia," read Jeanne, "but its population is equal to 24% of the population of Australia."

A good short cut

Ann found 25% of $24 as shown in the box.

To find 25% of $24, Leo thought "$\frac{1}{4}$ of $24 is $6." Leo knew that 25% is equal to $\frac{1}{4}$.

$$\begin{array}{r} \$24 \\ .25 \\ \hline 120 \\ 48 \\ \hline \$6.00 \end{array}$$

1. Whose method is shorter, Ann's or Leo's?

2. Leo can change a per cent to a fraction, like this:

$25\% = \frac{25}{100} = \frac{1}{4}$	$60\% = \frac{?}{?} = \frac{?}{5}$
$30\% = \frac{30}{100} = \frac{?}{10}$	$75\% = \frac{?}{?} = \frac{?}{4}$
$40\% = \frac{40}{100} = \frac{?}{5}$	$80\% = \frac{?}{?} = \frac{?}{5}$
$50\% = \frac{50}{100} = \frac{?}{2}$	$90\% = \frac{?}{?} = \frac{?}{10}$

Leo learned these facts by heart. Do you know them?

3. Use the short method to find 25% of each of the following:

$30 $36 $42 $84 $200

4. Find 50% of:

$2.50 $50 $68 $75 $97

5. Use the short way to find 75% of each of the following:

$80 $120 $12.40 $76 $68

6. What is the short way to find 20% of a number? 40%? 60%? 80%?

Without working these examples tell which is larger:

7. 49% of $60 or $\frac{1}{2}$ of $60

8. 76% of $80 or $\frac{3}{4}$ of $80

9. 26% of $30 or $\frac{1}{4}$ of $30

10. $\frac{2}{5}$ of $20 or 39% of $20

11. 61% of 30 or $\frac{3}{5}$ of 30

12. $\frac{4}{5}$ of 120 or 81% of 120

13. 19% of 60 or $\frac{1}{5}$ of 60

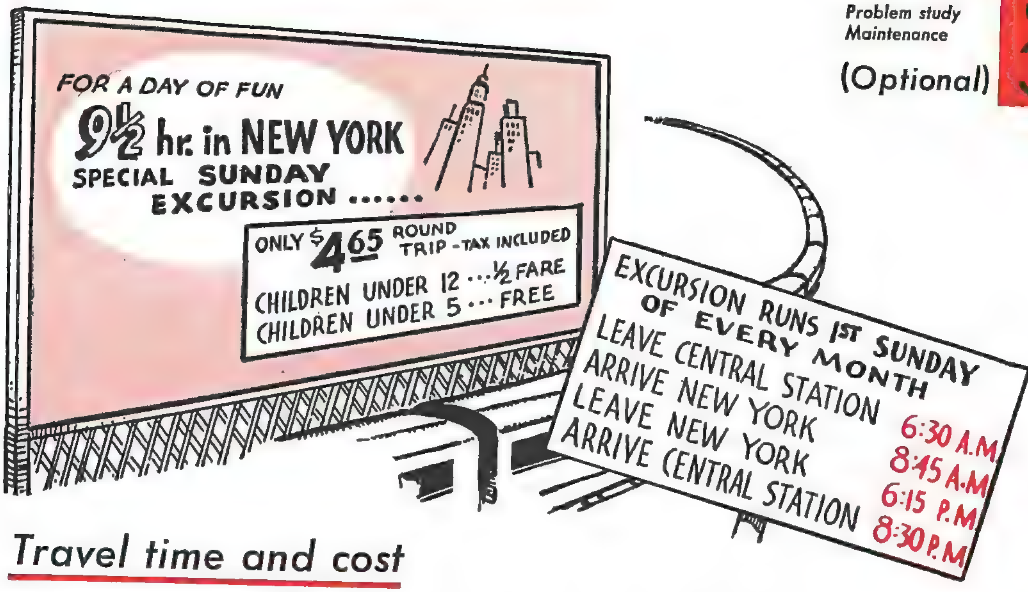
Which numbers do not belong in Exs. 14–18?

	a	*b*	*c*	*d*	*e*
14.	25%	$\frac{1}{4}$	.25	$\frac{25}{100}$	1.25
15.	$\frac{1}{5}$	20%	$\frac{20}{100}$	.20	$\frac{6}{5}$
16.	.30	$\frac{3}{10}$	30%	$\frac{30}{100}$	$\frac{3}{100}$
17.	$\frac{40}{100}$	40%	.40	$\frac{4}{100}$	$\frac{2}{5}$
18.	$\frac{3}{5}$	.60	$\frac{60}{100}$	60%	.06

19. At a special 25% reduction sale, what was the cost of a wool and nylon sweater priced regularly at $6?

20. Explain this advertisement: "Pay cash and save 10% on any article in the store."

How much would be saved by paying cash for a pair of shoes marked $5.00?



Travel time and cost

How much would it cost each of these families to go on the Sunday excursion to New York?

1. Mr. and Mrs. Simpson
   Harry Simpson.....age 13 yr.
   Jane Simpson......age 11 yr.
   Peter Simpson......age 7 yr.

2. Mr. and Mrs. Powers
   Rodney Powers.....age 12 yr.
   The Powers twins...age 8 yr.
   Susie Powers.......age 4 yr.

3. Mr. and Mrs. Gray
   Grandma Gray
   Lucy Gray........age 14 yr.
   Tom Gray.........age 10 yr.
   Lucille Gray.......age 2 yr.

4. Mr. and Mrs. Kline
   Bernice Kline......age 11 yr.
   Henry Kline.......age 9 yr.
   Anita Kline........age 5 yr.

5. The Simpsons have decided to go on the excursion the first Sunday of next month.

   Look at your calendar. What date will that be?

   How much time is left before the Simpsons take their trip?

6. The advertisement says they will be in New York for $9\frac{1}{2}$ hours. Check that statement.

7. How long will they be on the train going to New York? coming home?

8. How long will it be from the time they leave Central Station until they get back again?

9. It takes the Simpsons 40 minutes to go from their home to Central Station. Would you suggest that they leave home at 5:15 A.M., 5:40 A.M., or 5:50 A.M.?

To the Teacher: See Note 8 on page 310.

Problem study

1. Anita wanted $4\frac{1}{4}$ yd. of ribbon. At the five-and-ten-cent store she saw some that was $\frac{1}{3}$ yd. for 10¢ and some similar ribbon that was $\frac{1}{4}$ yd. for 10¢. She wanted to get the cheaper ribbon.
 Which kind was cheaper? What was the difference in the cost of $4\frac{1}{4}$ yd. of the two kinds of ribbon?

2. The Jones boys want to use 1 lb. of fertilizer to 10 sq. ft. of area on the front lawn. The lawn is 40 feet by 20 feet.
 How many pounds should they buy?

3. The weights of first-class air mail in five trips of the mail plane were 750.5 lb., 546.2 lb., 748.2 lb., 327 lb., and 548.8 lb.
 What was the weight of the average mail load?

4. Andy needs 5 yards of sail-cloth for a new sail for his boat. He can use $2\frac{7}{8}$ yards from the old sail.
 How many yards of new sail-cloth must he buy?

5. How many rolls of wall-paper border will be needed for a recreation room which is 14.5 feet long and 10 feet wide? Each roll contains 10 yards.

6. Marie is making 8 badges, each $3\frac{3}{4}$ inches long. Should she buy $\frac{2}{3}$ yd., $\frac{3}{4}$ yd., or $\frac{5}{6}$ yd. of ribbon?

7. The plan of Camp Pinnacle on the camp folder is drawn to the scale of $\frac{1}{8}''$ to $50'$.
 How far is it from the dining hall to the lake if the distance on the plan is $\frac{3}{4}''$?

8. At 3 for 5¢, how much will 36 screws cost?

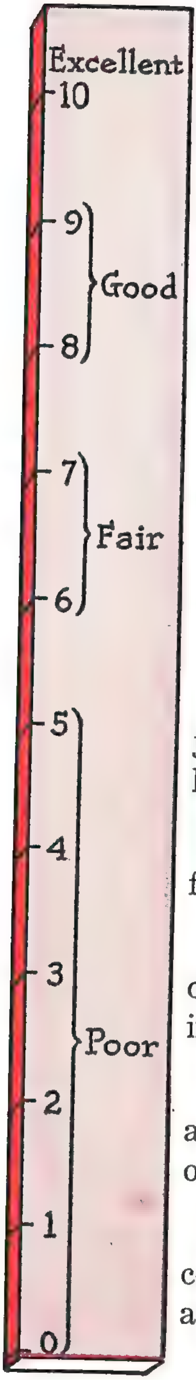
9. A daily plane from San Diego to Seattle flies the 1213.8 miles in 10.2 hours. What is its average speed?

10. Claire can stuff 20 dates in 15 minutes. How long will it take her to stuff 5 dozen dates for a school party?

11. A plane flew from Chicago to St. Louis at the rate of 119.5 miles an hour. From St. Louis to Denver it flew at 135 miles an hour. How much faster was that?

12. What is wrong with this statement? When Mr. Gray started on his trip, the trip meter in his car read 1072.8 miles and when he returned it read 137.81 miles. (The trip meter registers miles and tenths of a mile.)

Problem Test 8



1. Larry's receipts this month were \$24.17. His expenses were \$19.68. He has \$4.49 on hand. Show that his account balances.

2. A bridge will bear a load of 6000 lb. Should a truck that weighs 2 tons and carries a weight of $1\frac{1}{2}$ tons try to cross the bridge?

3. The directions on a package of Insect Killer read, "Use 2 parts of this powder to 3 parts of flour." If you use 6 tablespoons of powder, how much flour should you use?

4. Heavy cream weighs 8.37 pounds per gallon. How much will 20 quarts of heavy cream weigh?

5. Allan's brother told him that at the machine shop he uses sheets of metal so thin that a pile of 50 sheets is only 1.25 inches high. How thick is one sheet of the metal?

6. Dick was practicing the broad jump. In 5 trials he jumped 4.6′, 4.8′, 5.1′, 4.5′, and 4.7′. What was the average length of his jumps?

7. How many leather strips each $\frac{1}{6}$ yd. long can be cut from a piece of leather 6 ft. long?

8. How many more square feet of surface will the floor of Carl's chicken coop have if he makes it 12 ft. square instead of 18 ft. × 6 ft.?

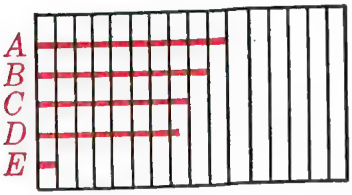
9. How much will the Miller children make if they buy a 5-pound box of candy for \$1.50 and sell the candy in 4-ounce bags for 10¢ a bag?

10. Elliott has saved 295 canned-milk coupons. Each coupon has a cash value of $\frac{1}{5}$¢. Has he saved enough to get an album marked 59¢ in the catalogue?

Write your score on your Problem Test Record.

Thinking about decimals

1. The paper shown below is ruled into columns one tenth of an inch wide. Use your ruler to test whether the width of ten of the columns is an inch.



2. Without using your ruler, can you tell the exact length of line A? of line B? line C?

3. Line D is .75 of an inch long. How can you tell that from the drawing?

4. Line A + line B = _?_

5. Line C + line D = _?_

6. Line A − line B = _?_

7. Line C − line E = _?_

8. Which line in the drawing illustrates that $9 \times .1 = .9$? that $.8 \div .1 = 8$? that .75 is halfway between .7 and .8?

9. Line A is _?_ times line E. Line D is _?_ times line E.

10. If line E were divided into 10 equal parts, each part would be .01 in. Why?

11. How many .01 inches are there in .1 inch? in .8 inch?

12. If an object is divided into 4 equal parts, each part is called one _?_ of the whole.

13. What is each part of an object called if it is divided into 10 equal parts? 100 equal parts? 1000 equal parts?

14. If each side of a square is 1 inch, its area is _?_ square inch.

15. If each side of a square is .1 inch, its area is _?_ square inch.

16. What number is midway between .1 and .2? between .01 and .02?

17. Can you tell the missing numbers here?

1000   100   _?_   1   .1   _?_   .001

18. What is one tenth of 150? 15? 1.5? .15?

Estimate the quotients in Exs. 19–22.

	a	*b*	*c*
19.	$.3\overline{)16}$	$.9\overline{)71}$	$.06\overline{)19}$
20.	$.5\overline{)39}$	$.4\overline{)13}$	$.07\overline{)64}$
21.	$.6\overline{)19}$	$.8\overline{)79}$	$.08\overline{)25}$
22.	$.7\overline{)64}$	$.03\overline{)16}$	$.09\overline{)7.1}$

Review practice

PRACTICE SET I

1. $\begin{array}{r} 49 \\ 86 \\ 70 \\ 58 \\ \underline{92} \end{array}$

2. $\begin{array}{r} 408 \\ 647 \\ 983 \\ 565 \\ \underline{376} \end{array}$

3. $\begin{array}{r} 1570 \\ \underline{-\ 875} \end{array}$

4. $\begin{array}{r} \$50.00 \\ \underline{-\ 12.65} \end{array}$

5. $\begin{array}{r} \$8.69 \\ \underline{\times\ 84} \end{array}$

6. $\begin{array}{r} \$2000 \\ \underline{-\ \$1980} \end{array}$

7. $\begin{array}{r} 980 \\ \underline{\times\ 608} \end{array}$

8. $\begin{array}{r} \$30.15 \\ \underline{\times\ 250} \end{array}$

Divide and check:

9. $7865 \div 9$
10. $1898 \div 50$
11. $7253 \div 8$
12. $5734 \div 68$
13. $\$52.52 \div 6$
14. $\$22.80 \div 8$
15. $\$24.08 \div 43$
16. $28.50 \div \$.75$

PRACTICE SET II

1. Copy and complete: 6,850,687 is read _?_ million, _?_ thousand, _?_.

2. Copy and complete: 18,050,600,000 is read _?_ billion, _?_ million, _?_ thousand.

3. Write in figures: eight million, six hundred fifteen.

4. Write in words: 20,000,750.

5. $476 + 97 + 208 + 687 + 924 + 835 + 275$

6. $\$.97 + \$1.14 + \$2.08 + \$.85 + \$.28 + \$.70 + \$1.50 + \$2$

7. From the sum of \$42.50 and \$8 take \$32.78.

8. Multiply \$9.42 by 5 and divide the product by 8.

9. How many 28's are there in 11,900?

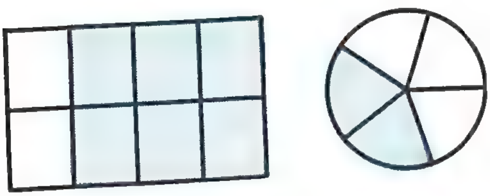
10. $8462 - 2354$
11. 576×808
12. $21\overline{)4284}$
13. $6000 - 2535$
14. 85×697
15. $88\overline{)352440}$
16. $\$80 - \$25.67$
17. $49 \times \$50.05$
18. $\$543.00 - \$205$

Mixed practice

1. In the following numbers name the digits in tenths place.

2.7 .076 2.16 3.6 .29 1.20

2. Write a decimal to show what part of each figure below is colored.



3. The mixed number $5\frac{6}{100}$ equals which of the following?

5.6 .56 5.06 5.60

4. Tell whether the missing word in each of the following is inches, feet, or yards.

- The area of the top of your desk is about 3 square _?_
- Your teacher is less than 2 _?_ tall
- The area of your classroom is about 500 square _?_
- The height of an ordinary door is about $6\frac{1}{2}$ _?_
- The volume of an ordinary cardboard shoe box is about 288 cubic _?_
- The area of the teacher's desk is about 10 square _?_
- The area of this page is about 50 square _?_

5. Tell whether the measurements in each pair are equal.

a	*b*
1 sq. yd.	9 sq. ft.
1 mile	5280 ft.
$16\frac{1}{2}$ ft.	1 mile
320 rd.	1 mile
1 sq. ft.	144 sq. in.
2000 lb.	$\frac{1}{2}$ ton
640 acres	1 sq. mile

6. What three measurements must you know before you can find the volume of a box?

7. Which is larger than 1:

- $12\frac{1}{2} \div 14$ or $14 \div 12\frac{1}{2}$?
- $12 \div 14\frac{1}{2}$ or $14\frac{1}{2} \div 12$?

8. Which is smaller than 1:

- $\frac{7}{8} \div \frac{1}{4}$ or $\frac{1}{8} \div \frac{4}{7}$?
- $\frac{4}{7} \div \frac{1}{8}$ or $\frac{1}{4} \div \frac{7}{8}$?

9. If you know $5\frac{2}{3} + 6\frac{5}{6} = 12\frac{1}{2}$, then do you know that:

- $5\frac{2}{3} + 5\frac{1}{6} = 10\frac{5}{6}$?
- $12\frac{1}{2} - 6\frac{5}{6} = 5\frac{2}{3}$?

10. If you know $\frac{7}{8} \times \frac{2}{3} = \frac{7}{12}$, then do you know that:

- $\frac{7}{8} \div \frac{2}{3} = \frac{21}{16}$?
- $\frac{7}{12} \div \frac{7}{8} = \frac{2}{3}$?

11. If you know $\frac{2}{5} + \frac{2}{5} + \frac{2}{5} = \frac{6}{5} = 1\frac{1}{5}$, then do you know that:

- $3 \times \frac{2}{5} = 1\frac{1}{5}$?
- $2 - \frac{4}{5} = 1\frac{1}{5}$?

Everyday problems

1. When oranges are selling at \$.75 a dozen, how many oranges can you get for \$.50?

2. When oranges are selling at \$.75 a dozen, how much will 4 oranges cost?

3. The weight of a small bag of potato chips is 12 ounces. The weight of a large bag of potato chips is 18 ounces. The small bag costs 36¢ and the large bag 48¢.

- Compare the weight of the large bag with the weight of the small bag.
- Compare the cost of the large bag with the cost of the small bag.
- Tell whether this statement is true: The large bag weighs $1\frac{1}{2}$ times as much as the small bag, but costs only $1\frac{1}{3}$ times as much.

4. Bob wanted to buy some paint. He found that pint cans of paint cost \$.60 and that quart cans cost \$1.00. Which statements below do you consider to be true?

- In pint cans, the cost of a quart of paint is \$1.20.
- If Bob needs only a pint of paint, he would be wasting money to buy a quart.

5. Find the cost of 2 doz. electric-light bulbs at 3 for 29¢.

6. The baggage limit per passenger in some airplanes is $60'' \times 24'' \times 19''$.

How many cubic inches of baggage is one passenger allowed?

7. Two frozen-food storage lockers are the same price. One is $2' \times 2' \times 3'$ in size. The other is $26'' \times 20'' \times 40''$.

Which locker would seem to be the better buy? Why?

8. Sally's mother paid Sally 2¢ a piece to iron. Sally ironed 5 pillowcases and 9 towels. How much did she earn?

9. Tell which boy earned more in 4 weeks:

- Eric had a steady job with Mrs. Warren at 30¢ an hour. He worked an hour a day 5 days a week.
- Sam did odd jobs at 40¢ an hour, and in the last 4 weeks he earned 60¢, \$1.20, 40¢, and 80¢.

10. If $\frac{5}{8}$ in. represents a mile, how many miles does a $1\frac{1}{4}$-inch line represent? a 5-inch line?

11. Ray wants to cover the roof of his hen house with asphalt roofing paper. The roof is $9' \times 15'$. A roll of paper covers 100 sq. ft. Will one roll of paper be enough?

Self-Help Test 15

1. Round off each number to the nearest thousand:
4,758 5,203 76,063 (10)

2. Express to the nearest cent:
$\$.04\frac{1}{4}$ $\$.15\frac{4}{5}$ $\$9.43\frac{1}{2}$ (208–209)

3. $4\frac{5}{6} + 1\frac{2}{3}$ (68)

4. $10\frac{1}{8} - 2\frac{3}{4}$ (72)

5. $9 \times \frac{2}{3}$ (86)

6. $\frac{3}{8}$ of 21 (91)

7. $12 \times 1\frac{1}{4}$ (115)

8. $5\frac{1}{2} \times 3\frac{2}{3}$ (111)

9. $8\frac{2}{3} \times \$.75$ (96)

10. $\frac{3}{4} \div 9$ (137)

11. $\frac{5}{6} \div \frac{1}{12}$ (136)

12. $14 \div 2\frac{1}{3}$ (133)

13. $9\frac{1}{3} \div 1\frac{1}{6}$ (143)

14. $\$1.80 \div \frac{2}{5}$ (135)

15. Would you estimate $12\frac{1}{5} \times 5\frac{1}{3}$ to be about 40, 65, or 96? (124)

16. How much will 8 tent poles cost at $62\frac{1}{2}$¢ each? Use a short way to find this answer. (275)

17. How many cubic inches are there in Ann's jewel box which is $2\frac{1}{3}'' \times 2\frac{1}{2}'' \times 5''$? (230)

Self-Help Test 16

1. Change to decimals:
$\frac{3}{5}$ $\frac{7}{10}$ $\frac{8}{25}$ $\frac{7}{20}$. (272)

2. 9 out of 20 is the same as _?_ out of 100. (270–271)

3. 16 out of 25 $= \frac{?}{25} = \frac{?}{100}$. (270–271)

4. What will 16 songbooks cost at 75¢ each? (Use the short method.) (275)

5. Miss Snow needs 756 in. of curtain gauze. How many yards should she buy? (47)

6. At the rate of 36.2 mi. an hour, how long will it take to go 217.2 mi.? (99)

7. If $\frac{1}{8}''$ represents 5 mi. on a diagram, how long a distance does $2\frac{1}{4}''$ represent? (150)

8. How much will it cost to dig a trench 50 ft. long, $1\frac{1}{2}$ ft. wide, and 2 ft. deep at a cost of 6¢ a cubic foot? (230)

9. $\frac{4}{5} = \frac{?}{100} =$ _?_ % (289)

10. 16% of 35 = _?_ (291)

Self-Help Test 17

1. Write in figures: four thousand three hundred and twenty-one hundredths. (161)

2. Is 2 hundredths written .02 or .002? (161, 164)

3. Arrange these numbers in order of size:

   .24 .186 .098 (166)

4. Find the sum of:
   $6.5 + 46.8 + .6 + 3.9 + 62.9$ (173)

5. What is the difference between 98.6 and 68.9? (174)

6. $.046 + .985$ (173)

7. $64.25 - 1.78$ (174)

8. $95 - 22.5$ (174)

9. $.8 \times .68$ (186)

10. $.03 \times 2.8$ (188)

11. $\$6.49 \div 10$ (205)

12. $.64 \times \$12$ (186)

13. $6\overline{)18.36}$ (198)

14. $9\overline{).198}$ (198)

15. $.8\overline{).656}$ (203)

16. $.12\overline{)172.8}$ (202)

17. $48\overline{)165.6}$ (198)

18. Find the cost of 100 whistles at 35¢ each. (191)

19. A playground 90 rd. by 40 rd. contains _?_ acres. (224–225)

20. Change $6\frac{3}{4}$ to an improper fraction. (60)

Self-Help Test 18

1. 36 out of 50 = $\frac{?}{50}$ = _?_ hundredths = _?_ per cent. (288)

2. How many yards of wire fencing will it take to enclose a garden 16′ by $12\frac{1}{2}$′? (120–121)

3. Traveling at the rate of 28.5 mi. an hour, how far can you go in 3.8 hours? (99)

4. At what rate per hour is Mark paid if he receives \$2.70 for working 4 hr. 30 min.? (135)

5. Find .08 of 234. (194)

6. What is the new price when a coat marked to sell for \$18 is reduced $\frac{1}{4}$ in price? (178)

7. Find 75% of 36. (291)

Measuring your growth in arithmetic

1. Jonathan read in a weather report that 30% of the days in the month of June had been rainy. How many rainy days were there in June?

2. Judy took a snapshot of her pony, and wishes to have an enlargement made. The picture is 2″ long and $1\frac{1}{2}$″ wide.

If Judy has the picture made 8″ long, how wide will it be?

3. This is Lucy's recipe for orange marmalade:

6 oranges	1 grapefruit
3 lemons	6 lb. sugar

If Lucy uses 12 oranges, how many lemons should she use? how many grapefruit should she use? how much sugar?

4. Find the cost of $2\frac{3}{4}$ lb. of nuts at 59¢ a pound.

5. Change $\frac{17}{20}$ to a per cent.

6. Find the cost of 48 baskets at 75¢ each. Use a short cut method.

7. George won 5 out of 6 games played. Bill won 8 out of 10 games played. Who made the better score?

8. Arnold sold 60 magazines at 10¢ each. How much did he earn if he kept $\frac{2}{5}$ of the amount collected?

9. If a map is drawn to a scale of $\frac{1}{4}$ in. to 75 miles, how long a distance is represented by a 2-inch line?

10. If 26% of the pupils in a class own bicycles, would you say that about $\frac{1}{2}$, $\frac{1}{3}$, or $\frac{1}{4}$ of the pupils own bicycles?

Just for fun

Here is an easy way to find 9 times a number by doing a *subtraction*. Can you explain why the trick works?

- ▶ Choose a number such as 67,823
- ▶ Annex a zero to the number → 678,230
- ▶ Subtract the original number → − 67,823
- ▶ The answer to 9 × 67,823 → 610,407

To check the answer multiply your original number by 9.

100 addition facts

Tell the answers. Then try to write all the answers correctly on folded paper. Study any facts you miss and take the test again. Keep practicing until you can write all the answers correctly in 4 minutes.

1.	4	3	4	1	9	7	2	2	2	4
	1	1	0	8	9	1	9	5	8	4
2.	1	9	8	1	1	7	2	6	5	3
	1	2	8	3	6	7	0	1	4	3
3.	0	7	1	0	8	1	2	3	5	0
	1	2	9	7	1	7	1	6	5	9
4.	3	4	0	6	8	6	0	2	0	2
	0	5	8	0	3	2	4	2	2	4
5.	9	5	6	3	4	1	9	8	6	1
	1	0	6	2	3	5	0	2	4	4
6.	6	3	3	3	2	3	6	2	9	0
	5	8	4	9	3	5	3	6	3	6
7.	5	4	1	5	7	2	8	4	8	1
	2	2	2	3	3	7	4	8	0	0
8.	5	9	6	6	0	0	5	7	8	7
	8	7	8	9	3	5	1	0	5	9
9.	8	9	5	8	8	4	7	4	5	7
	7	6	9	9	6	7	5	9	7	8
10.	6	0	5	4	7	7	9	3	9	9
	7	0	6	6	6	4	8	7	5	4

100 subtraction facts

Tell the answers. Then try to write all the answers correctly on folded paper. Study any facts you miss and take the test again. Keep practicing until you can write all the answers correctly in 4 minutes.

1.	6	3	7	4	5	8	6	6	2	5
	3	1	1	3	5	4	5	1	1	2
2.	9	5	5	1	8	4	6	9	4	9
	9	3	4	1	1	2	6	8	4	1
3.	5	0	3	5	9	8	10	3	3	7
	1	0	0	0	6	2	4	3	2	7
4.	8	9	7	6	9	7	12	10	8	11
	8	3	3	0	0	2	6	7	6	2
5.	10	6	10	7	9	8	4	2	7	6
	1	2	2	6	5	7	1	2	5	4
6.	11	9	10	10	14	11	13	15	8	11
	8	2	3	9	7	7	6	8	5	5
7.	8	7	12	10	10	12	10	7	12	1
	3	0	9	5	6	4	8	4	8	0
8.	14	13	16	14	17	8	2	9	9	4
	9	4	9	5	9	0	0	7	4	0
9.	13	16	13	13	11	14	15	17	15	13
	5	7	7	8	3	6	9	8	7	9
10.	12	11	11	16	18	11	12	15	14	12
	7	4	6	8	9	9	3	6	8	5

100 multiplication facts

Tell the answers. Then try to write all the answers correctly on folded paper. Study any facts you miss and take the test again. Keep practicing until you can write all the answers correctly in 4 minutes.

1.	4	3	4	1	9	7	2	2	2	4
	1	1	0	8	9	1	9	5	8	4
2.	1	9	8	1	1	7	2	6	5	3
	1	2	8	3	6	7	0	1	4	3
3.	0	7	1	0	8	1	2	3	5	0
	1	2	9	7	1	7	1	6	5	9
4.	3	4	0	6	8	6	0	2	0	2
	0	5	8	0	3	2	4	2	2	4
5.	9	5	6	3	4	1	9	8	6	1
	1	0	6	2	3	5	0	2	4	4
6.	6	3	3	3	2	3	6	2	9	0
	5	8	4	9	3	5	3	6	3	6
7.	5	4	1	5	7	2	8	4	8	1
	2	2	2	3	3	7	4	8	0	0
8.	5	9	6	6	0	0	5	7	8	7
	8	7	8	9	3	5	1	0	5	9
9.	8	9	5	8	8	4	7	4	5	7
	7	6	9	9	6	7	5	9	7	8
10.	6	0	5	4	7	7	9	3	9	9
	7	0	6	6	6	4	8	7	5	4

90 division facts

Keep practicing until you can write the answers to these division facts on folded paper in 6 minutes.

1.	$1\overline{)5}$	$4\overline{)8}$	$7\overline{)14}$	$5\overline{)25}$	$3\overline{)15}$	$7\overline{)35}$	$5\overline{)30}$	$2\overline{)18}$	$1\overline{)4}$
2.	$7\overline{)28}$	$8\overline{)0}$	$4\overline{)12}$	$9\overline{)81}$	$7\overline{)42}$	$8\overline{)8}$	$1\overline{)3}$	$5\overline{)35}$	$3\overline{)3}$
3.	$4\overline{)16}$	$9\overline{)9}$	$7\overline{)21}$	$7\overline{)49}$	$1\overline{)2}$	$8\overline{)16}$	$5\overline{)40}$	$2\overline{)16}$	$3\overline{)6}$
4.	$8\overline{)24}$	$9\overline{)0}$	$5\overline{)20}$	$5\overline{)45}$	$9\overline{)72}$	$6\overline{)0}$	$2\overline{)14}$	$7\overline{)56}$	$3\overline{)9}$
5.	$9\overline{)63}$	$6\overline{)6}$	$8\overline{)32}$	$5\overline{)15}$	$4\overline{)20}$	$7\overline{)7}$	$3\overline{)12}$	$7\overline{)63}$	$1\overline{)1}$
6.	$6\overline{)12}$	$3\overline{)0}$	$8\overline{)40}$	$4\overline{)24}$	$5\overline{)10}$	$9\overline{)54}$	$8\overline{)56}$	$2\overline{)12}$	$7\overline{)0}$
7.	$8\overline{)64}$	$2\overline{)0}$	$3\overline{)24}$	$4\overline{)36}$	$6\overline{)42}$	$9\overline{)27}$	$6\overline{)30}$	$2\overline{)8}$	$4\overline{)0}$
8.	$2\overline{)4}$	$1\overline{)9}$	$3\overline{)27}$	$6\overline{)36}$	$3\overline{)18}$	$8\overline{)72}$	$9\overline{)18}$	$1\overline{)8}$	$1\overline{)7}$
9.	$4\overline{)4}$	$2\overline{)6}$	$8\overline{)48}$	$2\overline{)10}$	$5\overline{)5}$	$4\overline{)28}$	$6\overline{)54}$	$9\overline{)45}$	$5\overline{)0}$
10.	$3\overline{)21}$	$2\overline{)2}$	$1\overline{)0}$	$6\overline{)18}$	$4\overline{)32}$	$6\overline{)48}$	$9\overline{)36}$	$6\overline{)24}$	$1\overline{)6}$

Tables of measurement

Length

12 inches (in.) = 1 foot (ft.)
3 feet = 36 inches = 1 yard (yd.)
$5\frac{1}{2}$ yards = $16\frac{1}{2}$ feet = 1 rod (rd.)
320 rods = 5280 feet = 1 mile (mi.)

Weight

16 ounces (oz.) = 1 pound (lb.)
100 pounds = 1 hundredweight (cwt.)
2000 pounds = 1 ton (T.)
2240 pounds = 1 long ton

Surface

144 square inches (sq. in.) = 1 square foot (sq. ft.)
9 square feet = 1 square yard (sq. yd.)
160 square rods = 1 acre (A.)
640 acres = 1 square mile (sq. mi.)
640 acres = 1 section

Volume

1728 cubic inches (cu. in.) = 1 cubic foot (cu. ft.)
27 cubic feet = 1 cubic yard (cu. yd.)
128 cubic feet = 1 cord

Time

60 seconds (sec.) = 1 minute (min.)
60 minutes = 1 hour (hr.)
24 hours = 1 day (da.)
7 days = 1 week (wk.)
30 days = 1 month (mo.)

12 months = 1 year (yr.)
365 days = 1 year
366 days = 1 leap year
10 years = 1 decade
100 years = 1 century

Monthly means once a month.
Semimonthly means twice a month.
Bimonthly means once every two months.
Annual means once a year.

Semiannual means twice a year.
Biannual means twice a year.
Perennial means year after year.
Biennial means once every two years.

Dry Measure

2 pints = 1 quart
8 quarts = 1 peck (pk.)
4 pecks = 1 bushel (bu.)

Liquid Measure

16 ounces (oz.) = 1 pint (pt.)
2 pints = 1 quart (qt.)
4 quarts = 1 gallon (gal.)

To the teacher

This series is planned to develop progressively the important concepts, relationships, and computational skills needed in arithmetic. In doing this, the books of the series organize the learning into a meaningful system of related ideas; they make maximum use of children's needs for number; and they provide the practice, self-diagnosis, and remedial work required to make learning permanent. Most careful attention has been given to the problem of reading for understanding. The books are the outcome of years of research and classroom experience.

For each grade there is available a Teacher's Guide. The Guide contains concrete suggestions for making the learning of arithmetic meaningful and interesting. It provides helps for utilizing the textbook material most effectively. It also gives a concise statement of the authors' philosophy and psychology of teaching the subject.

NOTE 1 (*Page 43*). On this page the pupil is being prepared for an important step in long division, namely estimating whether the quotient will be as many as 10, or 100, or 1000. He will repeatedly have to find 10, or 100, or 1000 times his divisor, and compare that product with the dividend. If he finds that the dividend is more than 10 times the divisor and less than 100 times the divisor, he knows that the quotient will be a 2-figure number. It is important that he become proficient in such mental comparisons.

NOTE 2 (*Page 49*). Up to this point the pupils have found trial quotient figures as on page 48. The method introduced on this page requires more judgment, and is highly recommended for the middle and upper ability group in your class.

NOTE 3 (*Page 51*). The letter N is used on pages such as these in place of the expression "what number." Do not let your former training in algebra mislead you into giving pupils algebraic rules for solving equations. The N as used in these exercises gives children practice in understanding the inverse relationship of multiplication and division, and the inverse relationship of addition and subtraction.

NOTE 4 (*Page 76*). One of the major objectives of this book is to teach children to think with numbers, to estimate, to use number sense rather than to operate blindly by rule. In Ex. 1 the pupil thinks, "The quotient is more than 10, because $10 \times 27 = 270$; it's more than 100, because $100 \times 27 = 2700$; it's more than 1000 because $1000 \times 27 = 27{,}000$; it's more than 2000 because $2000 \times 27 = 2 \times 27{,}000$, or 54,000." Such practice makes division meaningful.

NOTE 5 (*Page 89*). Pupils' responses should result from examination of the figures. Do not give formal rules for multiplying fractions at this time.

NOTE 6 (*Page 130*). Pupils should actually divide sheets of paper so that they understand the meaning of dividing by a fraction. Do not rush to get to the rule on page 131.

NOTE 7 (*Pages 172, 212, and 234*). On pages 172 and 212 ("Be your own teacher") are exercises designed to help children realize that they can without teacher or book guidance think out for themselves solutions to arithmetic situations that are new to them. Pupils will of course use a great variety of unconventional methods of solving the problems. These pages may be used to challenge the more able pupils to do independent, creative, quantitative thinking. Solutions should be compared and evaluated by the participating pupils. Do not attempt to teach conventional methods.

NOTE 8 (*Page 255*). The units and individual pages indicated as "Optional" suggest to the teacher material that she can omit if she teaches in a short-term school or has a slow-learning group.

Index and back page not required.